MECHANICAL ENGINEERING

April 1960

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Automatic Welding

THIS SINGLE UNIT WILL HEAT 1,728 HOMES

B&W 100,000 lb per hr Boiler was shipped "SHOP ASSEMBLED"...ready to go to work

This shop-assembled B&W FO Package Boiler—being shipped as a single unit—is on its way to handle an important job.

The FO Boiler will supply all the steam to heat a new $22 million, 1728 family cooperative apartment house in New York City. Simplicity of installation is only one of the FO Boiler's attractive features: just remove it from the flatcar or truck, make the necessary connections, and start it up.

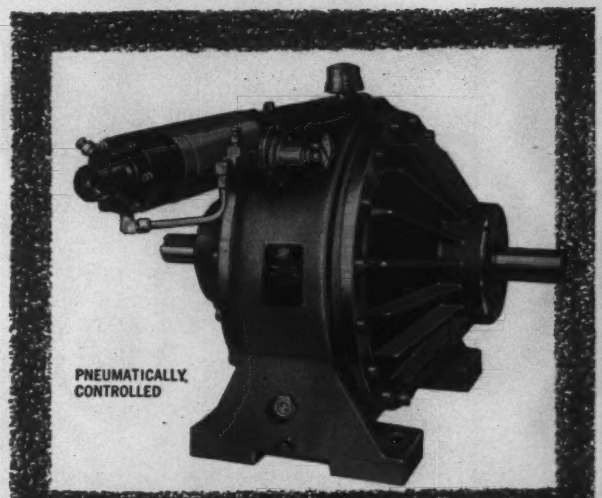
This natural circulation boiler delivers up to 100,000 lb of steam per hour. It's B&W designed, to give you reliable high capacity with minimum maintenance in a small space. If you have a problem involving steam, B&W—with nearly a century of experience in the design and manufacture of steam generating equipment—will be delighted to help you. Just write to The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G-975-1B

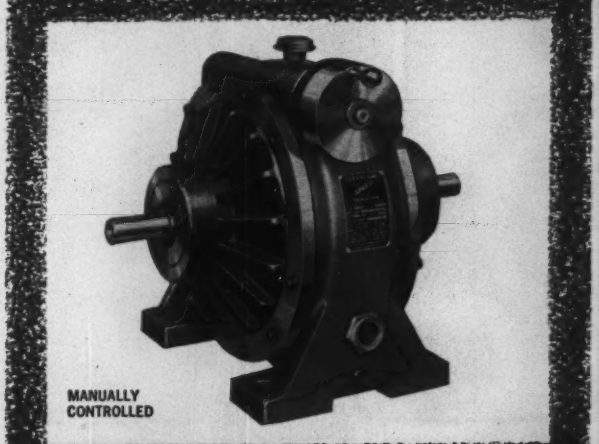
B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION



PNEUMATICALLY CONTROLLED



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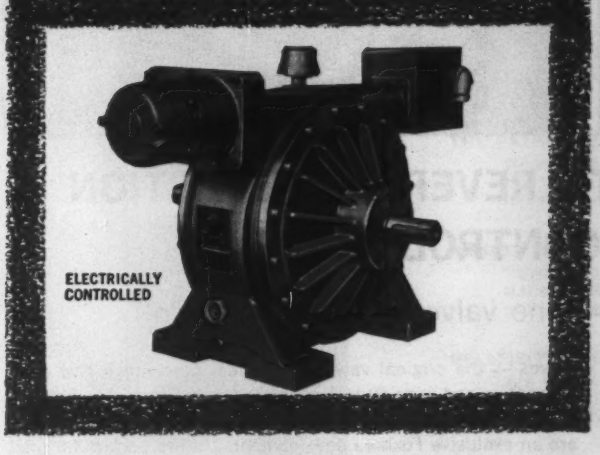


ELECTRICALLY CONTROLLED

with Cleveland Speed Variators... precision control is a simple matter

Cleveland Speed Variators — mechanical traction-type variable drives with stepless speed control — provide both increase and decrease of output speed on a range up to 9:1 from a constant speed power source.

Infinitely variable speed regulation is provided with instant, smooth change by either manual, automatic, or remote control. Precise adjustments are easily made with accurate adherence to settings. Some typical examples:

For the Chemical Industry
In rubber processing seventeen variators provide necessary process flexibility when changing production from one type synthetic rubber to another.

For the Automotive Industry
Variators give accurate control of assembly line speeds to control conveyor output rates.

For the Tobacco Industry
Variators make delicate adjustments for electronic beta gage controller.

For the Steel Industry
Variators provide remote control speed change on processing line conveyor.

For the Metal Working Industry
Variators permit fast, accurate adjustment of machining speeds for metals, from magnesium to 38 Rc steel.

For the Wire Products Industry
Variators control four reels simultaneously — and without slippage.

In Ore Processing
Variators easily adjust rate of material feed to hammermill.

In Material Handling
Variators control movement of steel tubes through 176-roll annealing furnace.

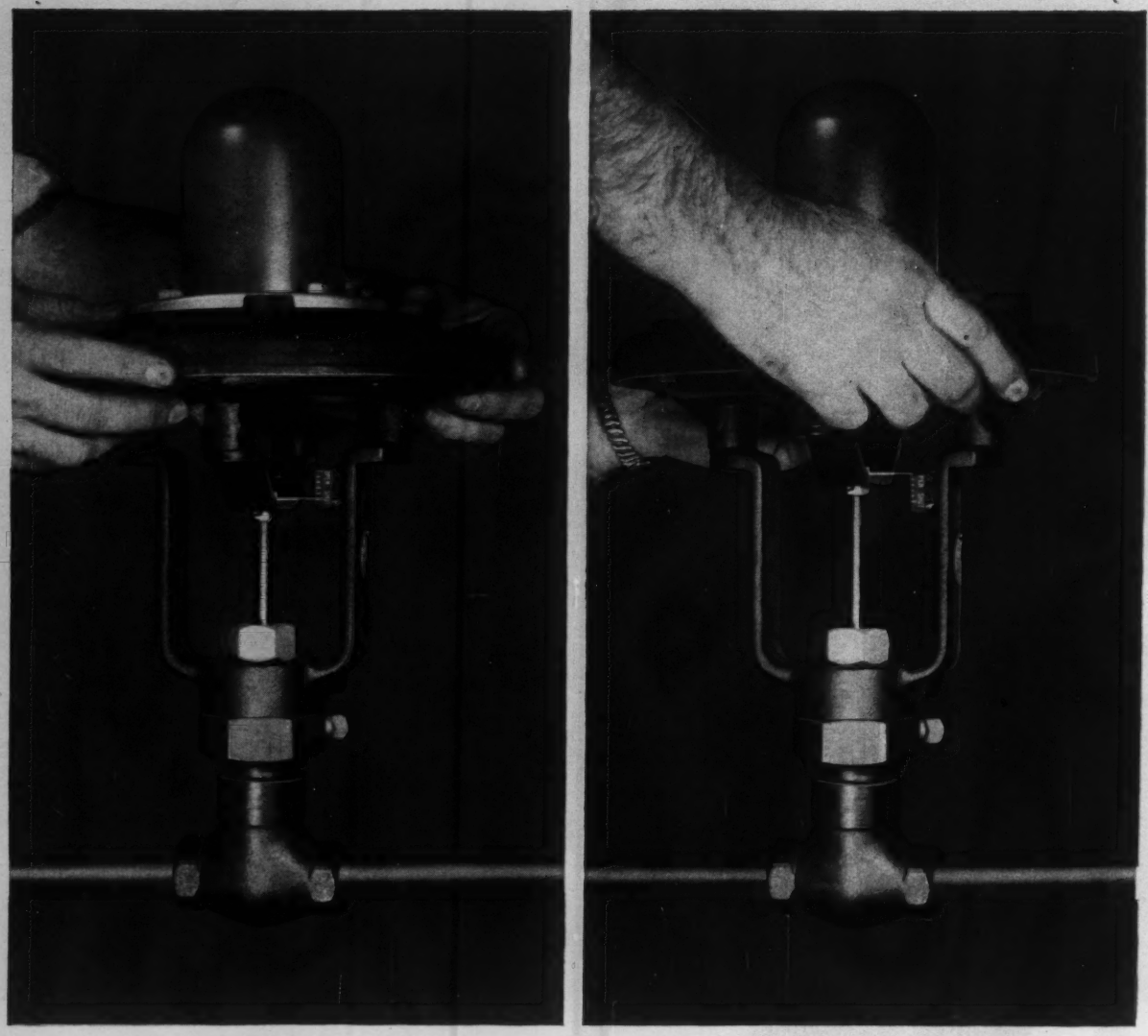
Cleveland Worm & Gear Division
Eaton Manufacturing Company
3264 East 80th Street • Cleveland 4, Ohio

Send for your free copy of Bulletin K-250. It gives the complete Variator control story.

HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, right).

CLEVELAND VARIATOR



LOOK HOW EASY IT IS TO REVERSE THE ACTION OF A FOXBORO CONTROL VALVE!

air-to-open . . . air-to-close — one valve for the job of two

Unbolt the motor casing and rotate it 90°; rebolt and shift air connections — that's all you do to reverse the operation of a Foxboro control valve. Takes just a few minutes — without touching valve body or process piping — without employing special tools or skills.

Foxboro reversible motors are especially suited for needle valves, Saunders-type valves, and other control valves having non-reversible bodies. They're also used with Foxboro Stabilflo* Valves — the original valves with equal percentage flow characteristics and wide 50 to 1 rangeability.

Foxboro control valves with their quick-reversible valve motor, are an exclusive Foxboro development. They're perfect for pilot plant operations and other processes frequently "juggled." Types and materials to meet any process requirement.

Write for detailed bulletins today. **The Foxboro Company, 964 Neponset Ave., Foxboro, Mass.**

*Reg. U.S. Pat. Off.

FOXBORO

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MECHANICAL ENGINEERING

PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

VOLUME 82 • NUMBER 4 • APRIL, 1960

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THE COVER

Automatic submerged-arc welding made a 30-hr job out of one that might otherwise have taken 10 weeks. To weld core structurals for an atomic reactor, the Tapco Group of Thompson-Ramo-Wooldridge, Inc., of Cleveland, Ohio, used fully automatic welding heads made by the Linde Company, Division of Union Carbide, also of Cleveland. For the total of 300 ft of welds, multipass welding was required, 5 to 22 passes per weld, the steel ranging in thickness from three-quarters in. to 3 in. One man controlled the entire operation from the console.

AN ENGINEER LOOKS AT EDUCATION.....**G. B. Warren** 58

Try this for size: A teacher teaches fewer pupils today than in 1900. Could we do better, with modern audiovisual equipment and modern organization? Yes, says ASME Past-President Warren.

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CONTROL OF AIR POLLUTION.....**H. C. Austin and W. L. Chadwick** 63

Smog formation? In Southern California, they had to find out what really caused it, and which contaminants resulted in significant air pollution. Here is a report on industry's fight against smog.

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Near Sioux Falls, S. D., another nuclear power station will go on the line in 1962. A group of midwest utilities took part in the research and development. A feature: Controlled recirculation.

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"Synthetic" is the word—for scientific and economic reasons, and for national defense. Must be inert to chemicals, resistant to heat, oxygen, ozone. The new materials affect all engineering.

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Are you with it? In two areas, engineers already are grappling with problems involving such high velocities as to require the calculations of relativity. Can your mind accept the "twin paradox"?

WINGS THAT WON'T STALL?.....**J. S. Kishi** 81

Suction through perforations in the upper wing surface can control turbulence, postponing stall. This paper won ASME's Old Guard Prize for 1959, for best paper and presentation by a Student Member.

FLASH EVAPORATORS.....**E. F. Stalcup, E. F. Coxe, and R. L. Coit** 84

The flash evaporator, in which sea water flashes into vapor, produces high-purity feedwater for boiler make-up, becoming part of the regenerative cycle. Scale formation is almost eliminated.

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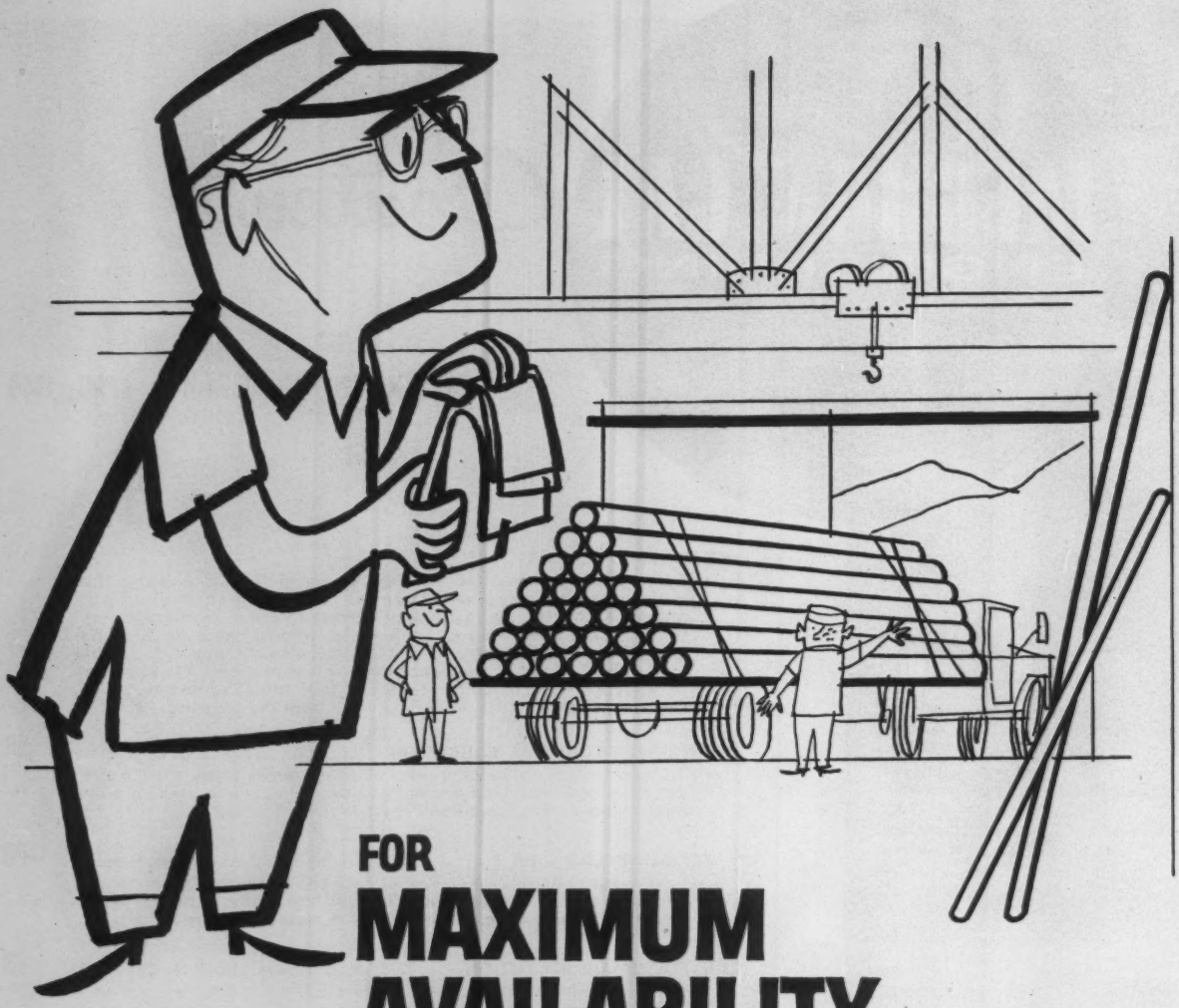

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B&W offers you . . .

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- a complete variety of tube finishes — hot-finished, turned, cold-drawn or roto-rocked
- service from 2 tube mills—plus a nationwide network of district sales offices and steel service centers manned by *experienced* tube salesmen—ready to serve you *promptly*

These are just a few of the many reasons why it pays to specify B&W Job-Matched Seamless Mechanical Tubing. And remember—matching tubes to jobs assures you the *right tube,* in the *right quantity,* at the *right time.* For more information, call your local B&W District Sales Office, or write for Bulletin TB-430. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

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TUBULAR PRODUCTS DIVISION

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

MECHANICAL ENGINEERING

PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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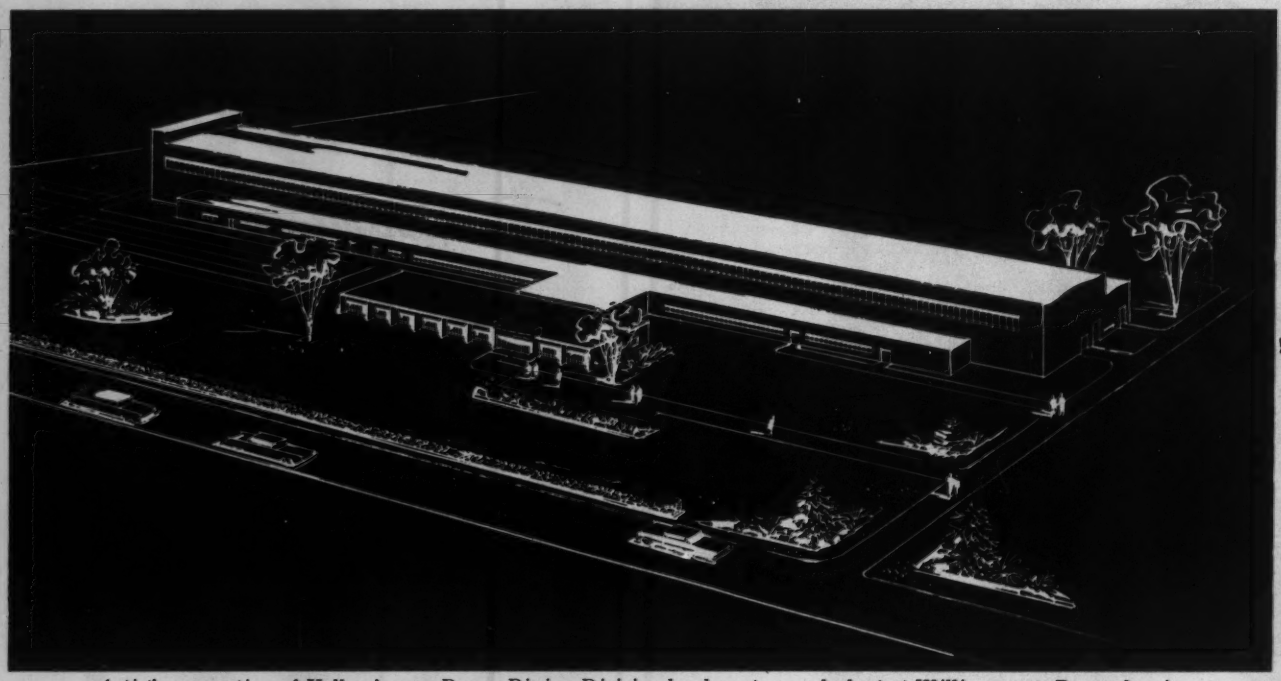
To Serve Electric



Artist's conception of Kellogg's new Power Piping Division headquarters and plant at Williamsport, Pennsylvania. The entire site covers about 50 acres.

KELLOGG

As operating temperatures and pressures increase in central power generating stations, the need for stronger and superior materials, and for better methods of manufacturing power piping systems, becomes more acute.

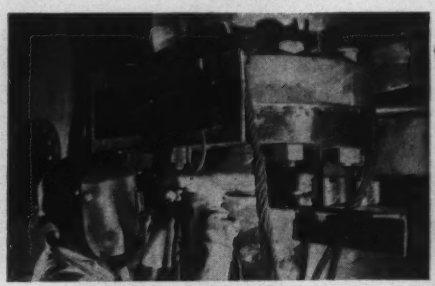
To help solve these problems, The M. W. Kellogg Company's Power Piping Division is building new metallurgical and welding laboratories as part of its complete manufacturing facilities at Williamsport.

The laboratory facilities and personnel, in addition to performing applied research and development for manufacturing power piping, will be available for consultation with clients on their problems and will act as a customer service laboratory.

In the laboratory, a Kellogg metallurgist places sample of austenitic steel in heat-treating furnace. After heat treatment, the steel sample will be cut into sections and tested.

In the pipe bending shop, a length of stainless steel piping is bent to close tolerances. Dam in pipe retains inert gas introduced during heat treating to prevent oxidation.

In the welding shop, two heavy-walled sections of stainless steel power piping are joined by K-Weld—an inert gas-shielded technique of arc welding, patented by Kellogg, which assures long life.



In the customer's plant, a Kellogg operator uses K-Weld to install heavy sections of power piping which carry superheated steam from boilers to generators.

Utilities Still Better

Power Piping Division of M. W. Kellogg is Building New Headquarters and Manufacturing Plant in Pennsylvania

To still further improve the service it has given to electric utilities for over 40 years, the Power Piping Division of The M. W. Kellogg Company is now building new headquarters and a plant at Williamsport, Pennsylvania.

To be completed by Labor Day, the plant will specialize in the manufacture of high pressure, high temperature alloy and carbon steel piping for electric generating stations. Centrally located in Pennsylvania, Kellogg's Williamsport plant will be within easy distance from many Eastern industrial centers. From here, it is well situated to serve clients by road, rail, or air.

Representing an investment of approximately $4 million, these new facilities will have no equal in the power piping industry. Incorporating the most modern and time-saving equipment, the facilities have been designed throughout for maximum efficiency and economy.

With completion of its new plant, Kellogg will be better equipped than ever to start with any power piping problem from scratch, and to carry it through to the actual installation in customers' central stations from coast to coast.

At its new plant, Kellogg will have the engineering skills to manufacture complex piping systems; the men and equipment to cut, machine, bend, weld and heat treat piping of varying sizes and wall thicknesses.

Here, Kellogg will have the equipment to make electronic, radiographic, ultrasonic and other advanced tests to inspect the quality of the finished product. Here, it will have the metallurgical and welding laboratories to evaluate new and superior piping materials; to maintain a continuing program of development in welding and other manufacturing techniques, and add still further to its line of industry "firsts" listed at the right.

Kellogg's Power Piping Division welcomes inquiries on its new facilities from engineers of power generating companies, consulting engineers, and manufacturers of turbines, boilers, and allied equipment.

OTHER KELLOGG FIRSTS IN POWER PIPING

In 1931, Kellogg manufactured the first all-welded piping for the first high-temperature, high-pressure central station in the United States. Kellogg manufactured the first austenitic steel piping for a central station installation and has been continually experimenting since to establish the best materials, manufacturing techniques and heating cycles for welding and post-welding treatment, and to set specifications for electrodes.

FIRST IN MANUFACTURING OF:

Piping from C ½% Mo
Station piping for 900 F.
Station piping for 950 F.
Station piping for 2200 psi
C ½% Mo piping with
#3-#5 actual grain size
1¼% Cr-½% Mo steam piping
Steam piping for 1000 F.
½% Cr-½% Mo station piping
2% Cr-½% Mo station piping
Station piping for 1000 F.
2¼% Cr-1% Mo station piping
1¼% Cr-½% Mo station piping
1% Cr-1% Mo V turbine piping
2¼% Cr-1% Mo V station piping
Station piping for 1050 F.
3% Cr-1% Mo station piping
Type 347 stainless turbine piping
Mercury vapor piping for 1000 F.
Station piping for 1003 F. for France
Type 347 stainless station piping
Station piping for 1100 F.
Type 316 stainless station piping
Type 316 stainless station piping for
3500 psi-1050 F., 325 MW
Type 316 stainless station piping for
5600 psi-1200 F., 325 MW

KELLOGG

POWER PIPING DIVISION · THE M. W. KELLOGG COMPANY

711 THIRD AVENUE, NEW YORK 17, N. Y. • A SUBSIDIARY OF PULLMAN INCORPORATED

Offices of Kellogg subsidiary companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires.

NEW LOOK IN NUCLEAR SUBS . . . The Navy's new submarine Skipjack, built by General Dynamics Corporation's Electric Boat Division in Groton, Connecticut, features a revolutionary blimp-shaped hull and diving planes on the sail (formerly known as the conning tower). Although her speed is classified, Skipjack is the fastest of the A-Subs.

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: BOSTON, BIRMINGHAM, CHICAGO, CLEVELAND, DALLAS, LOS ANGELES, NEW YORK, SAN FRANCISCO

"HYDROFORGED" FINE-GRAIN STAINLESS PIPE FOR THE NUCLEAR NAVY*

THE PROCESS: The starting point is a high quality machined hollow billet made centrifugally which is cold expanded by hydrostatic pressures up to 50,000 PSI in specially designed massive metal dies. After "hydroforging", the pipe is given a recrystallizing anneal which results in the grain refinement characteristic of wrought stainless steel.

THE PRODUCT: After final machining of the O. D. and I. D. surfaces to 125 micro inch finish, the pipe is subjected to all the testing requirements of Military Specification MIL-T-18063A (Ships) which covers seamless austenitic steel tubes and pipe intended for radioactive system service. This specification includes: chemical analysis, tensile properties (for Type 304 stainless steel—75,000 PSI minimum tensile strength, 30,000 PSI minimum yield strength, 35% minimum elongation), expanding and flattening tests, hydrostatic pressure test, intergranular corrosion test, macro-etch, ultrasonic and liquid penetrant examination.

*** U. S. NAVY SERVICE APPLICATIONS FOR HYDROFORGED STAINLESS INCLUDE:**

Pipe for valve operating system reservoirs and primary water preheaters

Primary coolant piping for nuclear submarines and surface ships

Seamless welding fitting stock for large diameter reactor piping systems for submarines and surface ships

Demineralizer shells

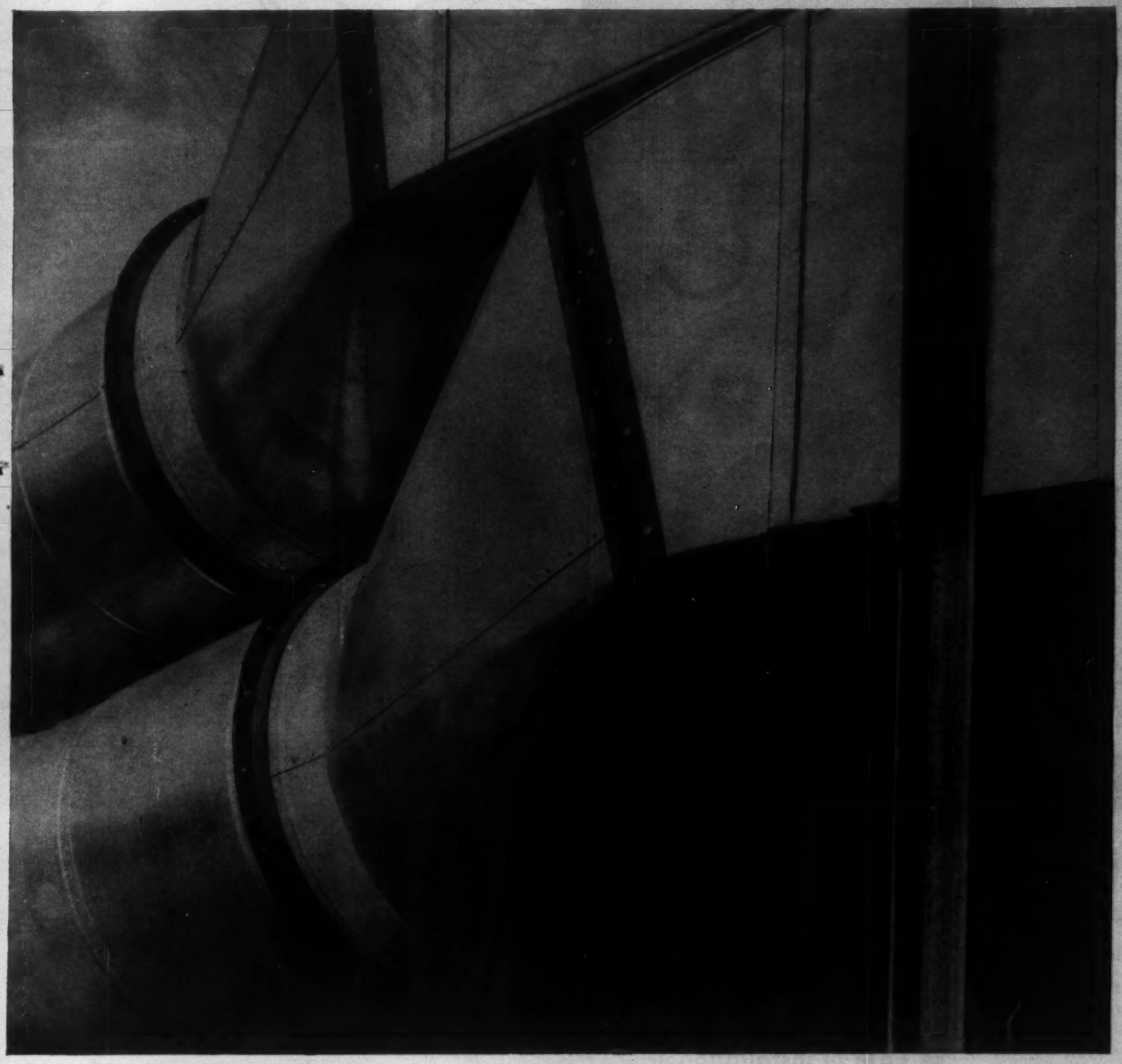
Operation: Dust Control

(One of a series)

At National Cash Register, 10 tons of wood

Dust is trapped at the source by hoods engineered for the individual job . . .

. . . and is piped from 160 locations to five giant Pangborn Cloth Bag Collectors.



shavings, chips and dust are collected daily!

Mammoth is the word for the 5-floor woodworking plant of National Cash Register headquarters, Dayton, Ohio. Processing nearly 300,000 sq. ft. of lumber each month, this operation generates 10 tons of waste material per day.

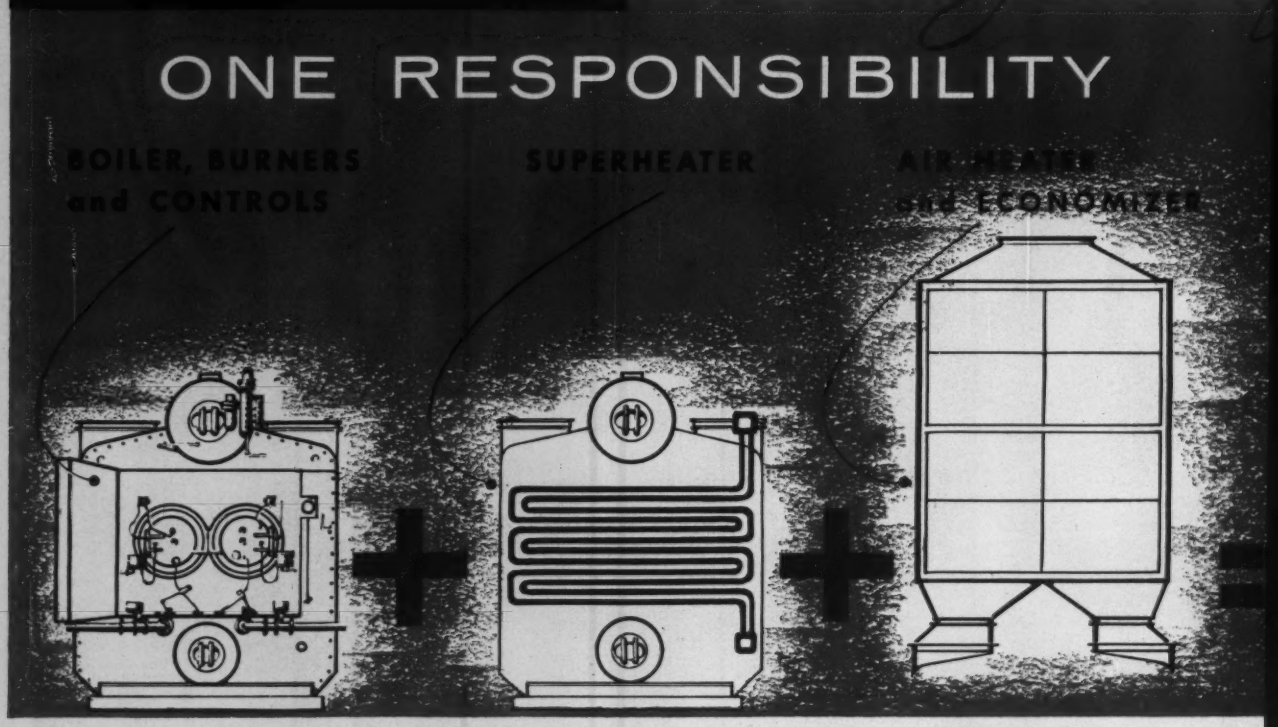
To protect NCR employees, equipment, plant and neighborhood, five Pangborn Cloth Bag Dust Collectors trap 90 cu. ft. of fine dust for disposal and, during the winter months, permit recirculating of the already-heated, cleaned air. This efficient performance of Pangborn Dust Control saves thousands of dollars in heating costs during the cold weather. In addition, a neighborhood and health nuisance has been eliminated; equipment maintenance and plant housekeeping costs have been minimized.

Dust a continuing problem in *your* plant? Talk to the Pangborn man in your area or write: PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control, Blast Cleaning, Vibratory Equipment—Rotoblast® Steel Shot and Grit.®*

Pangborn
OF HAGERSTOWN

KEYSTONE *Package*

ONE RESPONSIBILITY

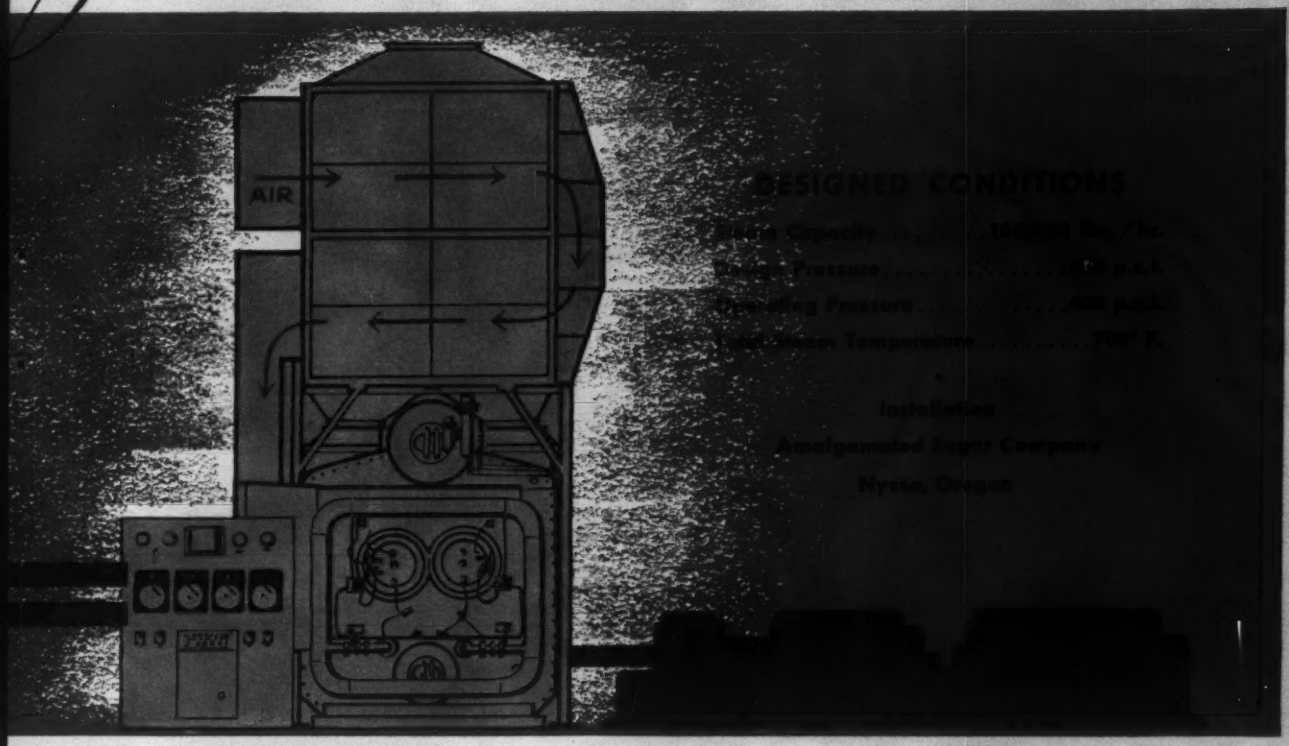


"Some of the best liked features of our KEYSTONE Steam Generator"

Amalgamated Sugar Company
Nyssa, Oregon

- **Ease of installation**
- **The large turn-down ratio of the gas burners**
- **Fast response to steam demands**
- **Minimum space for maximum capacity**
- **Minimum of attention required for operation**
- **High over-all efficiency of unit**

for Power Generation



Low Capital Investment

HERE ARE the power plant components normally associated with large field erected steam generators. These are packaged in a low cost, highly efficient installation. The boiler utilizes an integral Drainable Superheater to produce high temperature steam for use in a generating turbine. The Air Heater preheats the combustion air to provide efficiencies equal to utility standards.

Low first cost of this packaged installation saves considerable money over the cost of a similar field erected unit with no decrease in quality or efficiency.

If your problem is one of adding high pressure and high temperature steam for process work, power generation, or at low capital expenditure, to assist your present boilers during peak loads, then investigate Power Packages by Erie City Iron Works. Write for additional information in Bulletin SB-5903-D.

You can depend on ERIE CITY *Since 1840* *for sound engineering*

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STEAM GENERATORS • SUPERHEATERS • STOKERS • PULVERIZERS
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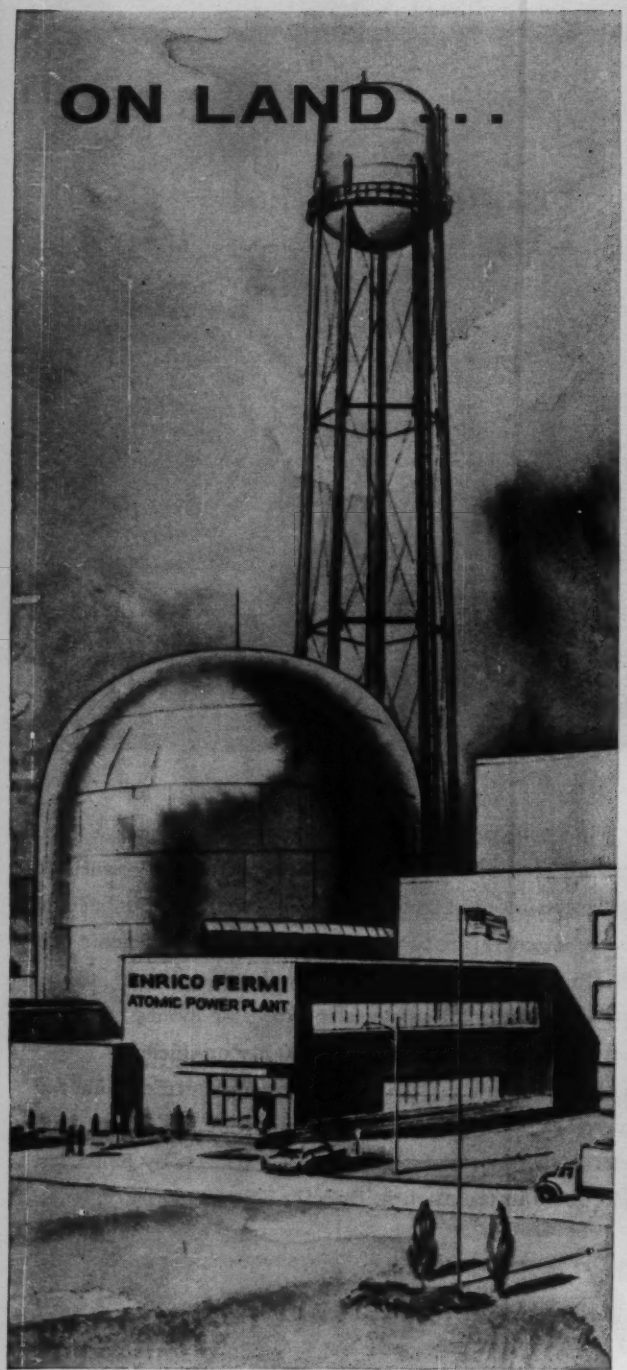

At the Enrico Fermi Atomic Power Plant, instruments and controls for both the "fast neutron breeder" reactor and the steam plant which it will "fire" are being furnished by Bailey.

Many of the new ships such as this super-carrier, USS Ranger, operate their boilers by Bailey Meter Control. Cargo ships, tankers, and passenger liners as well as Naval ships improve the economy and safety of their steam plants thru use of Bailey controls.

At the Thomas H. Allen Electric Generating Station of the City of Memphis, Tenn., Bailey operating indicators and controls for combustion, feed water, and steam temperature are centralized on the mechanical benchboard directly ahead, while the operating records which reflect trends are mounted on the vertical boards. A Bailey METROTYPE Information System, center left in the photo, scans, monitors, and logs functions usually assigned to strip-chart recorders.

IT'S BAILEY. . .

for the latest and safest instruments and controls for nuclear and conventional power plants!

Many of the power plants of the future will have controls and instruments designed and built by Bailey. There are two reasons: Bailey's continuing research and development toward the latest equipment for industry's needs; Bailey's 40-year association with the hardware and economic requirements of the industry.

If you are planning new or improved power plant facilities, call on Bailey engineers to assure that your system will have the *proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.*

Call on Bailey for primary sensing devices, indicators, loggers, control units, panels, data handling equipment, computers for performance analysis, and supervisory controls. You'll find designs ranging from conventional to the most sophisticated . . . mechanical, pneumatic, electric and electronic, including solid state.

There's a Bailey District Office or Resident Engineer close to you. Check your phone book, or write direct.

A144-2

Instruments and controls for power and process

BAILEY METER COMPANY

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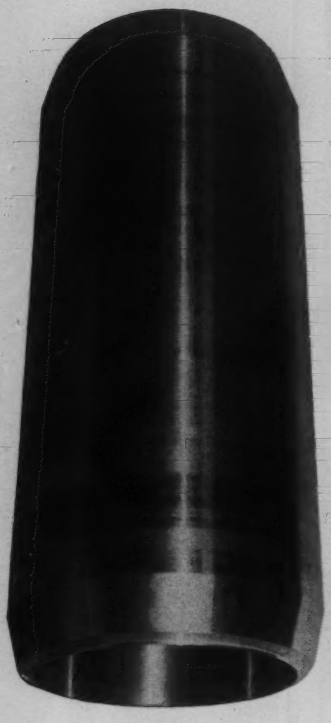
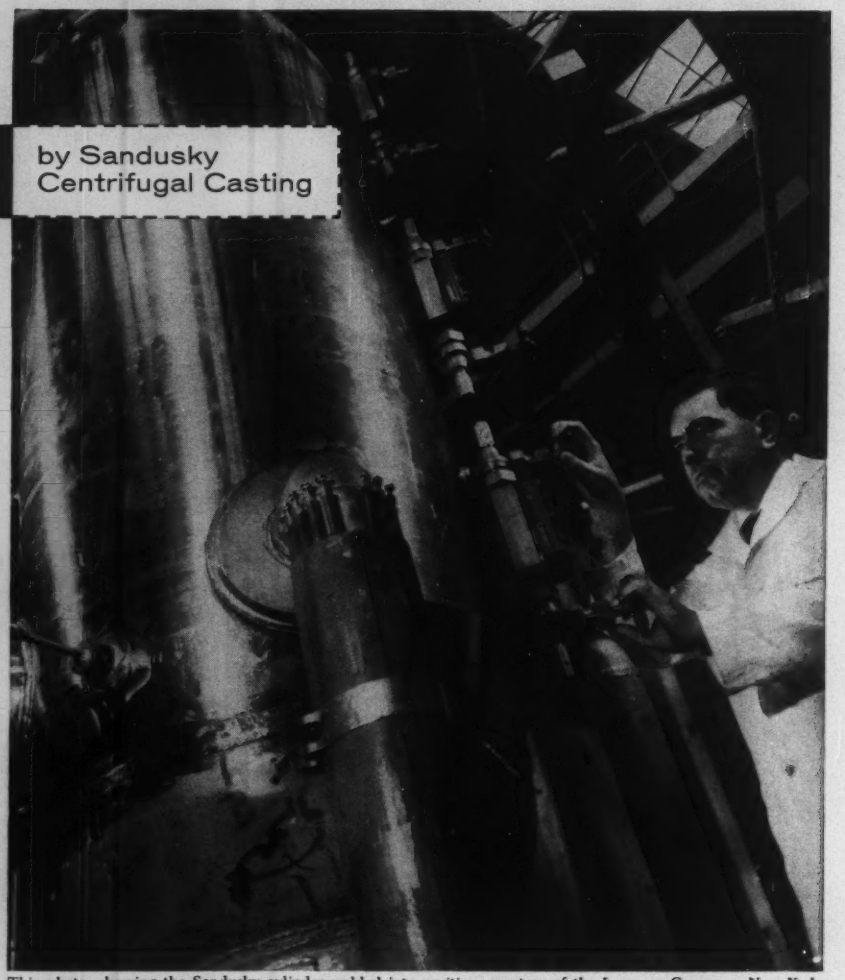
In Canada—Bailey Meter Company Limited, Montreal

SOLVED: by Sandusky Centrifugal Casting





This photo, showing the Sandusky cylinder welded into position, courtesy of the Lummus Company, New York. New York who fabricated, assembled and tested the completed loop before shipping it to the ETR site in Idaho.

Nuclear Test Loop Uses Sandusky Centrifugal Casting as Pressurizer Cylinder

A Sandusky Centrifugal Casting is the main cylindrical component of an electrically heated pressurizer, designed by Knolls Atomic Power Laboratory to Section VIII, of the ASME Code (Unfired Pressure Vessels) for use in the new Engineering Test Reactor facilities at Idaho Falls, Idaho.

This 66¼" long cylinder, 27" O.D. with walls 2½" thick, was centrifugally cast of an 18-8 stainless steel (SA-351, Grade CF-8) for the extra corrosion resistance required under nuclear loop service conditions: demineralized water at temperatures to 650°F and pressures to 2500 PSI.

O. G. Kelley Co., Boston, to whom we delivered this 2-ton, fully machined cylinder, welded on the forged heads and nozzles, radiographed the welds, and hydro tested the completed vessel to 4300 PSI.

This is another example of the adaptability of Sandusky Centrifugal Castings to applications demanding the highest order of quality. They may well offer you a practical and economical answer to your cylindrical needs, also.

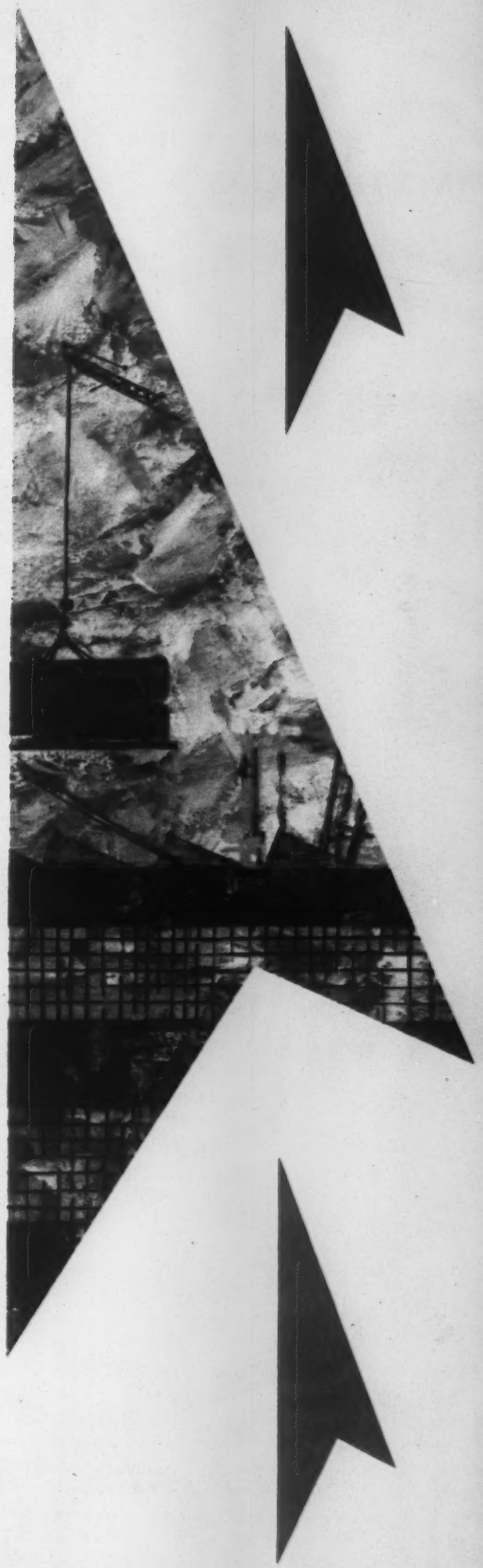
We are producing cylinders and piping in diameters from 7" to 54"—in lengths to 33 ft.—in a wide range of ferrous and non-ferrous alloys. Write for Bulletin 300, for more complete technical information on the Sandusky process and product application data.

SANDUSKY CENTRIFUGAL CASTINGS

FOUNDRY & MACHINE CO.

5903

SANDUSKY, OHIO—Stainless, Carbon, Low-Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys



New from American-Standard
Industrial Division

Air-Lift† for Industrial Plants

. . . helps you control total inplant environment

Air-Lift . . . a new concept of coordinated products and services from American-Standard Industrial Division . . . can help raise the productivity and profitability of your business through better control of air conditions throughout your plant.

To see how Air-Lift works . . .

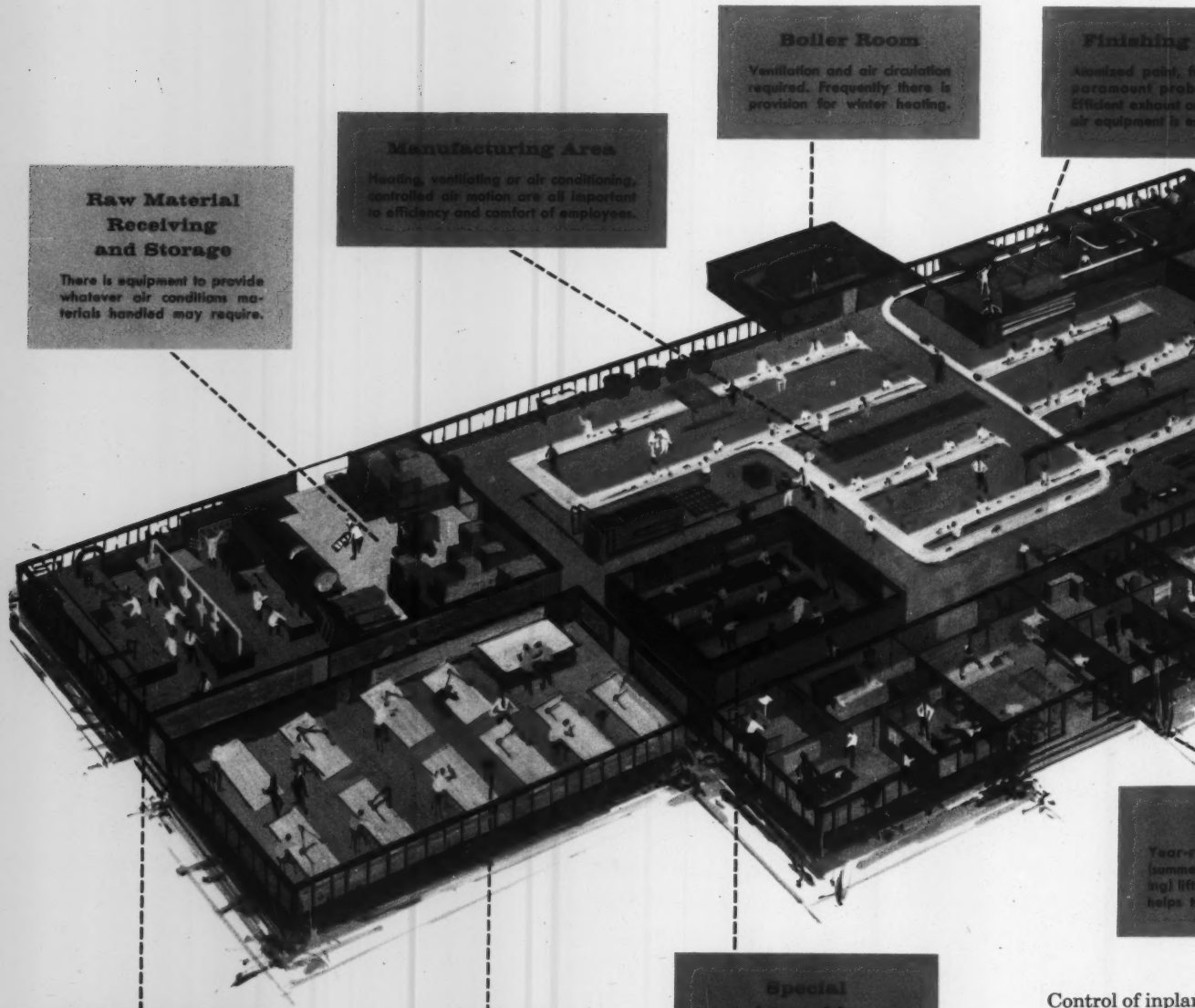
← LIFT THE FLAP

† Service-mark of American-Standard

American-Standard Industrial Division AIR-LIFT IN ACTION

BETTER AIR . . . profitable first st

in plant modernization pr


Boiler Room
Ventilation and air circulation required. Frequently there is provision for winter heating.
Manufacturing Area
Heating, ventilating or air conditioning, controlled air motion are all important to efficiency and comfort of employees.
Raw Material Receiving and Storage
There is equipment to provide whatever air conditions materials handled may require.
Research
Certain types of laboratory work present severe hazards to employee health, require close control of dust, fumes, vapors, gases, air velocities.
Engineering
Air conditioning pays dividends in accuracy. Employees are more efficient, more alert in comfortable environment.
Special Assembly
Highly specialized equipment can provide air conditions to order . . . control temperature, humidity, air motion, and air cleanliness with precision.

Control of inplan
to precise regul
ment, and air
Division offers
are the produc
American-Stand
a realistic unde
It is yours to d
for the air con

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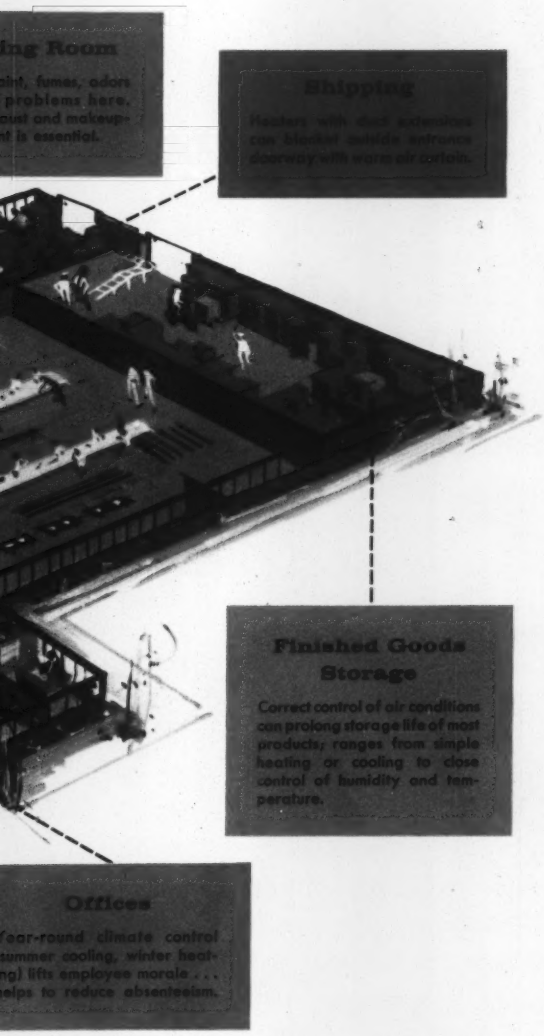
step

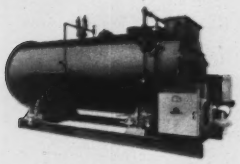
programming



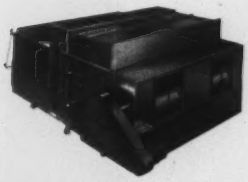
nplant environment varies from simple ventilation regulation of temperature, humidity, air move- air cleanliness. American-Standard Industrial ffers products to handle the entire job. These oducts of Air-Lift. Long experience has given Standard Industrial Division product specialists understanding of the many problems involved. to draw on in selecting a system of components conditions you need. This is Air-Lift service.

One-source responsibility for systems or components that meet your needs

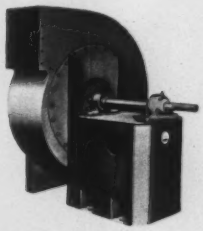
Centrifugal refrigerating machines for central-station systems.



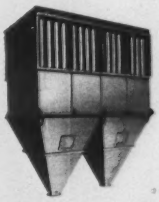
Firebox, scotch-type steel boilers, package units for heat, steam.



Central-Station air-conditioning units for cooling and heating.



Industrial fans with wheel types for air, gases, materials, shavings.



Dust collectors and fly ash collectors for effective air cleaning.

One-source responsibility

The heart of American-Standard Industrial Division's Air-Lift Service

Now . . . with the combined American Blower, Ross Heat Exchanger, and Kewanee Boiler product lines . . . American-Standard* Industrial Division offers *all* the major components for complete, integrated systems to control inplant environment.

You benefit by getting air-conditioning, air-handling, heating, and air-pollution-control equipment designed, engineered, and manufactured to work together. And—most important—you have one-source responsibility for its quality and performance.

Offices in all principal cities are staffed by product specialists whose practical knowledge of equipment selection and application may prove most helpful to you. May we serve you? AMERICAN-STANDARD INDUSTRIAL DIVISION, DETROIT 32, MICHIGAN. IN CANADA: AMERICAN-STANDARD PRODUCTS (CANADA) LIMITED, TORONTO, ONTARIO. EXPORT DIVISION, AMERICAN-STANDARD, NEW YORK CITY.

Products designed, engineered, and manufactured to work together

AIR CONDITIONING

Centrifugal refrigerating machines Central station units • Fancoil units • Self-contained air conditioners • Package water chillers Multi-zone air conditioners Sprayed coil dehumidifiers • Heating and cooling coils • Air washers

AIR HANDLING

Industrial fans with wheel types for handling air, gases, materials, and shavings • Centrifugal, propeller, tubeaxial, and vaneaxial fans • Utility sets • Power roof ventilators • Centrifugal compressors • Specialized fans, blowers

HEATING

Firebox, scotch-type steel boilers and package units for heat, process steam • Vertical and horizontal unit heaters for steam or hot water Heavy-duty heating coils • Industrial unit heaters • Heating and ventilating units • Cabinet heaters

AIR POLLUTION CONTROL

Dust collectors and fly ash collectors for eliminating dust and recovering fly ash • Cyclone-type centrifugal dust collectors • Disposal systems • Tubular-type centrifugal collectors • Package units • Electrostatic precipitators

POWER TRANSMISSION

Gyrol® Fluid Drives for stepless, adjustable-speed control of driven machinery • Complete range of sizes, 1 hp thru 12,000 hp • All provide extremely smooth pickup of the load, affording maximum protection for motor and machine

HEAT TRANSFER

Standard and engineered heat exchangers, condensers, and feedwater heaters for every requirement Oil and gas coolers • Refrigeration condensers and coolers • Instantaneous water heaters for service-water, booster, convertor duty

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

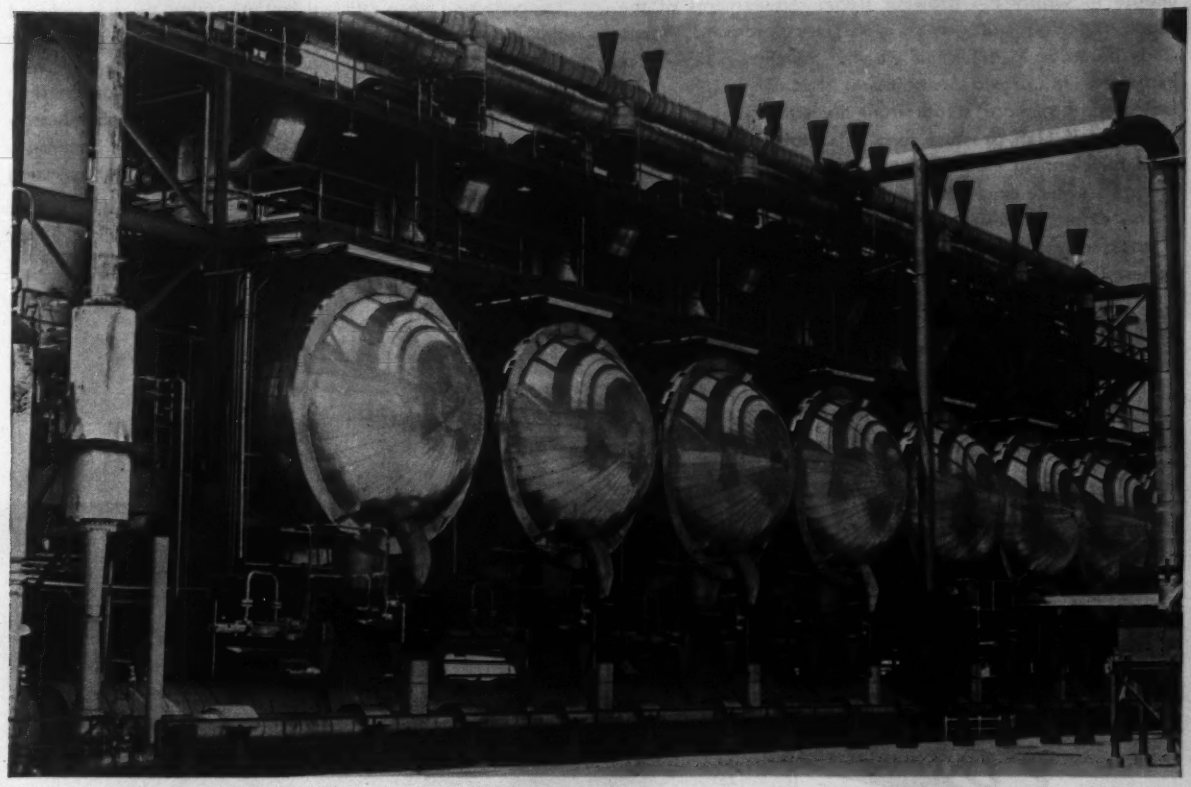
AMERICAN-Standard
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

85½ in. dia. expansion joint connecting quench and pre-quench towers. Pinned structural ties permit expansion joint to absorb axial and differential vertical movement.

48 in. dia. expansion joint at compressor discharge. Double bellows permit large axial movement. Internal sleeve guide provides for stability, minimum pressure drop.

54 in. dia. hinged expansion joints in loop to pre-quench tower. They absorb 5⅜ in. vertical expansion and 7⅛ in. horizontal expansion due to 1200°F temperature in reactor header.



125 ZALLEA EXPANSION JOINTS, 125 demands for maximum reliability

Expansion joints, specially engineered and designed by Zallea, solve problems of space, heat and flow for Odessa Butadiene Co., Odessa, Texas.

Large-diameter piping (up to 72 in. dia.), with short, straight runs and critical flow conditions, posed new design problems. High temperature operation (1200°F) required minimum loading on sensitive equipment. Open-air construction, with few load carrying members dictated maximum stability of expansion joints with minimum use of external guides and anchors to support pipe weight and resist wind loading.

To solve these problems called for a competent, close-working team of process, piping and structural engineers from Fluor Corp. Ltd., design engineers from Odessa Butadiene Co., and application engineers from Zallea.

Result: A compact, reliable piping-expansion joint system that permitted containment of an efficient, 50,000 ton per year unit in an area whose largest dimension is a few hundred feet.

This is another example of how Zallea experience in handling critical, complex Expansion Joint applications can save time and money. For more facts, call us . . . or write for catalog 56.

ZALLEA BROTHERS, Taylor and Locust Sts., Wilmington 99, Del.

Zallea FOR MAXIMUM RELIABILITY

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

AT ASHLAND, KY. WORKS OF ARMCO STEEL CORPORATION

"Increased boiler capacity can often be obtained by modernizing boiler cleaning equipment. Another benefit of such modernization is more efficient utilization of the fuel . . . getting more heat into the steam for useful work and wasting less heat up the stack.

For example, at the Ashland, Kentucky Works of the ARMCO Steel Corporation there are four boilers that were unable to supply the growing steam requirements of the plant. The high exit gas temperatures suggested that a study be made to determine whether the cleaning could be improved to provide additional capacity. This study indicated that more steam from the same fuel could be expected if high pressure long retractable blowers were used for cleaning instead of the rotary blowers with which the boilers were originally equipped.

The expected results seemed sufficiently promising and it was decided to modernize the cleaning equipment of one boiler. The seven rotary blowers were replaced with four Diamond Long Retracting Blowers, one of which is shown below. This modernization proved to be justified as the boiler's maximum steam output was increased 11% and the exit gas temperature was reduced approximately 100° F.

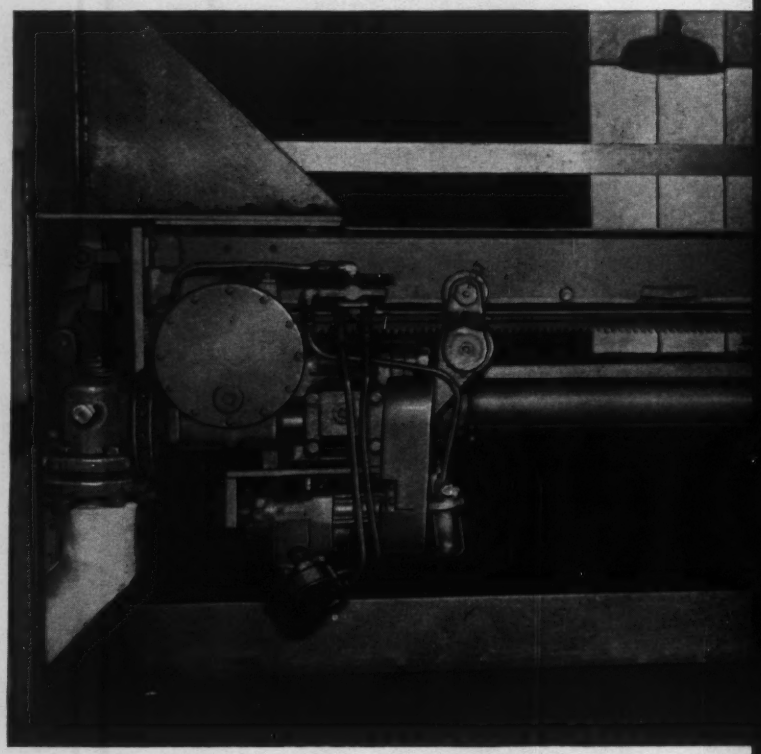
A "Boiler Cleaning Modernization Program" is well worth careful consideration because it can mean substantial savings in so many ways. In addition to increased capacity and more efficient fuel utilization, there is reduced maintenance . . . also reduced operating costs when motorized units and automatic operation are installed. Even though your boiler cleaning was the best at the time it was installed, improvements since then will probably pay off. For many years Diamond has been doing continuous research to improve boiler cleaning and boiler cleaning equipment.

Ask the nearest Diamond office (or write directly to Lancaster) to make a study of your boiler cleaning . . . the possible savings may surprise you."

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

DIAMOND SPECIALTY LIMITED • WINDSOR, ONTARIO



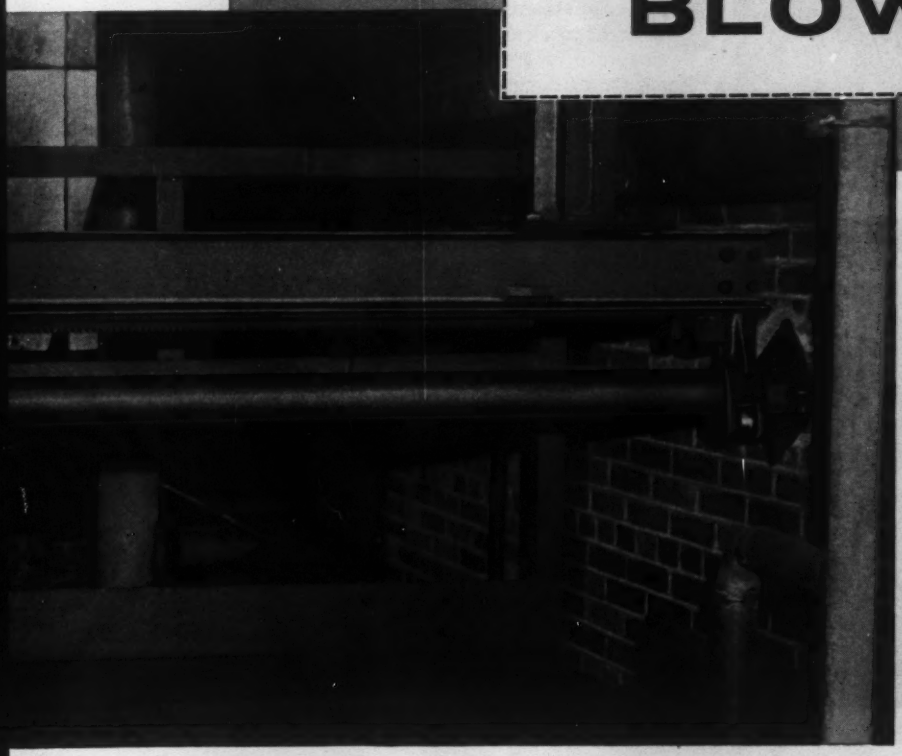
The Mark of

BETTER BOILER CLEANING AT LOWER COST

11% More Steam 100° F Lower Exit Gas Temperature

RESULT FROM BOILER CLEANING MODERNIZATION PROGRAM

Using DIAMOND LONG RETRACTING BLOWERS

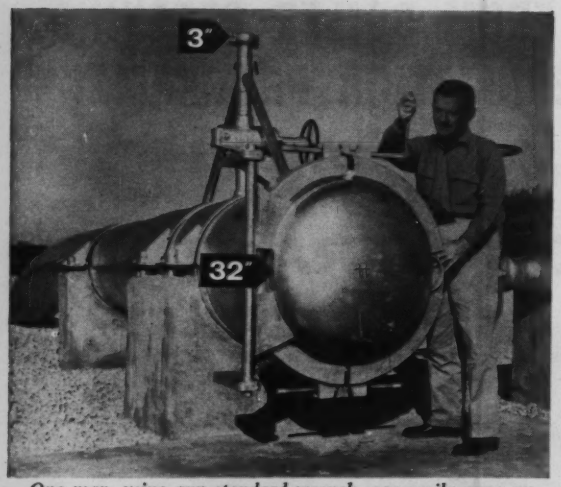


One of the four Diamond Long Retracting Blowers used to modernize the cleaning of the first boiler at the Ashland Works of ARMCO Steel Corporation. The results were so satisfactory that the three other boilers in this plant are now also being modernized.

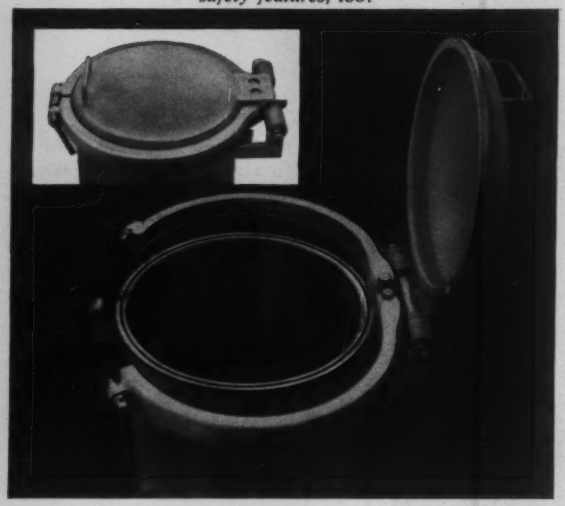
8257

NEW...FROM TUBE

an improved hinged closure for pipe lines, piping and process equipment



One man, using any standard wrench, can easily open or close the TUBE-TURN *Hinged Closure. Has important safety features, too!*



For vertical applications, TUBE-TURN *Hinged Closures can be equipped with spring-loaded, counterbalanced caps.*

Tube Turns announces a new line of hinged closures with important advantages for pipe lines, piping and process equipment wherever frequent access is required or where the use of blind flanges would be cumbersome and time consuming. Proved in scores of applications by major companies, the unique TUBE-TURN* Hinged Closure provides these benefits:

Saves installation time. Light weight assembly easier to handle. Completely fabricated . . . ready to install. Requires only one butt-weld to join to pipe, tank or vessel opening.

Saves operating cost. One man, using a standard wrench, can easily open or close the largest size closure in a few minutes. No threads or lugs to engage or flanges to line up. No parts to fail. No hammering or tugging. Can be adapted to motorized operation. Closures for vertical applications can have counterbalanced caps for easy operation.

Saves on maintenance. Oil resistant, self-energizing static "O" ring provides seal. Does not move when cover is opened or closed. No rubbing or chafing to shorten seal life.

Built-in safety. Exclusive design features of two-piece yoke, double-ended right- and left-hand threaded bolts and hinged cap guard against accidental opening under pressure.

These new TUBE-TURN Hinged Closures provide still another *plus value* you can get when you specify TUBE-TURN products and buy them from your nearby Tube Turns' Distributor. They are available in sizes 2" through 42" for A.S.A. 150-lb, 300-lb and 600-lb service . . . in steel or alloys.

*"TUBE-TURN" and "⊕" are trademarks of Tube Turns.

TURNS...

FREE BULLETIN . . . Complete information on the new line of TUBE-TURN Hinged Closures will be sent on request. Mail coupon.

TUBE TURNS, Dept. ME-4
224 E. Broadway • Louisville 1, Kentucky

Please send Bulletin TT956 on new TUBE-TURN Hinged Closures.

Company Name _____

Company Address _____

City _____ *Zone* ____ *State* _____

Your Name _____

Position _____

Another tt *plus value from...*

TUBE TURNS

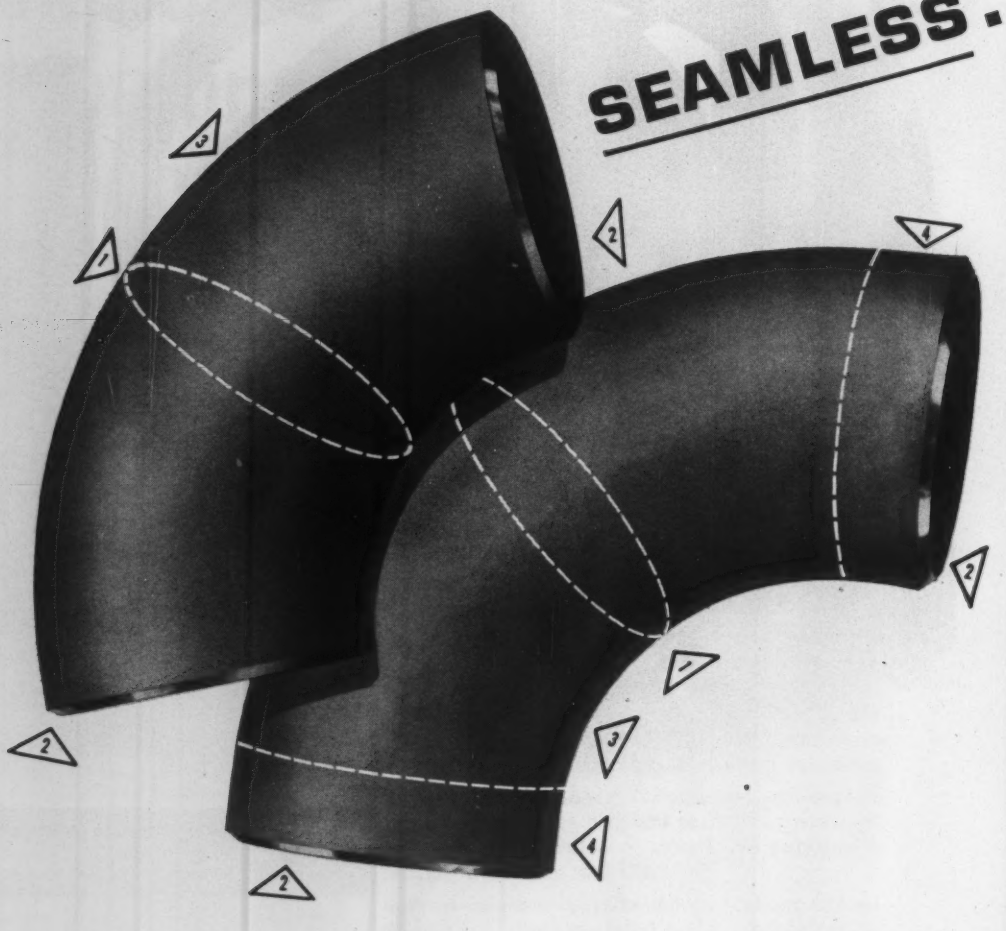
DIVISION OF CHEMETRON CORPORATION
Louisville 1, Kentucky

CHEMETRON

DISTRICT OFFICES: Atlanta • Chicago • Columbus • Dallas • Denver • Detroit
Houston • Kansas City • Los Angeles • Midland • New Orleans • New York
Philadelphia • San Francisco • Seattle • Tulsa
IN CANADA: TUBE TURNS OF CANADA LIMITED • Ridgetown, Ontario
DISTRICT OFFICES: Edmonton • Montreal • Toronto

NOW...BOTH!

SEAMLESS.



1. BONUS... All fittings hot-coined in compression throughout entire length—dimensionally true to permit segmenting at any point. **2.** BONUS ... Seamless and welded-type fittings with specially machined ends assure uniform thickness and diameters . . . ends that are circle-perfect, plumb and square. **3.** BONUS... Wall thickness and uniformity—greater than required by ASA Standards. **4.** BONUS... Long Tangent bonus on welded-type fittings—NO EXTRA COST—saves pipe, simplifies lining-up, eliminates short welded stubs.

5951

..BY MIDWEST

NEW! The finest *seamless* welding fittings ever made. NOW—a hot-coined fitting, dimensionally accurate from end to end . . . fittings forged at controlled heat for superior metallurgical quality . . . with specially machined ends for quickest fit-up and welding! Produced by the newest and most modern equipment—combined with the latest technology in forging, sizing, heat-treating, and machining. Available in all sizes through 24″—long radius or short—90's, 45's, 180's.

WELDED . . . BY MIDWEST

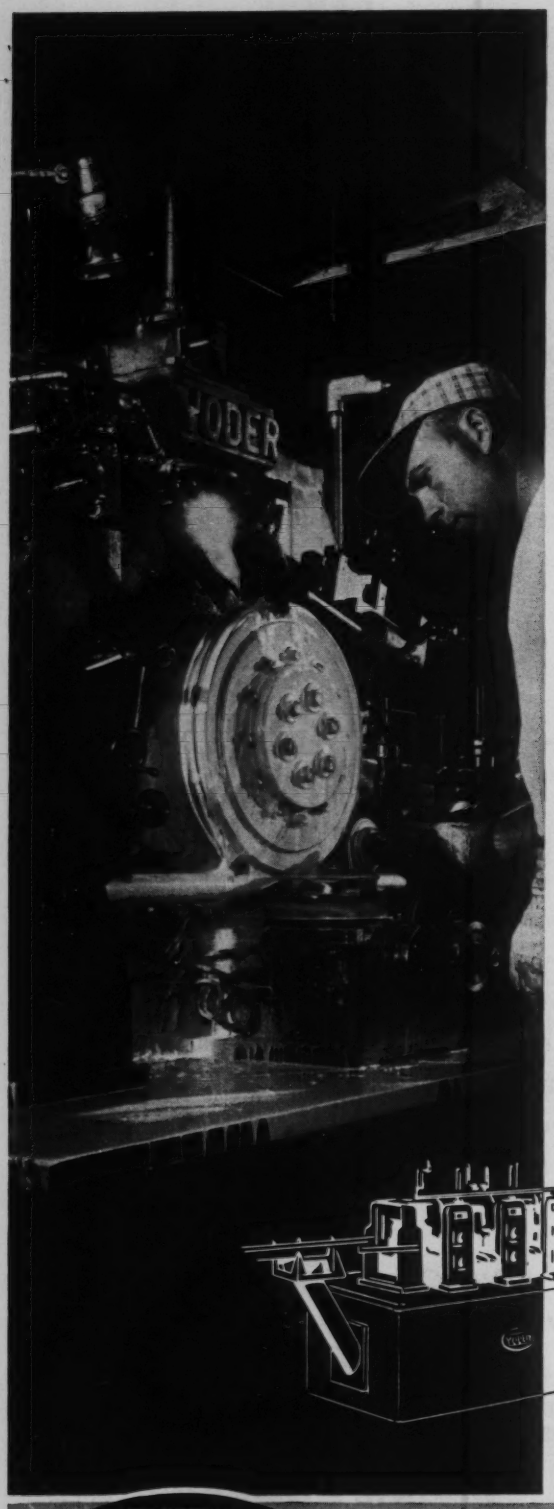
Welded-type fittings, fully reinforced . . . especially "Long Tangent" bonus fittings . . . always available from stock in carbon steel through 36″ (to order through 48″)—same high quality as always. Also available from stock in wrought iron and chrome-moly. Fittings formed from plate and welded are ideally suited to unusual requirements—heavy wall (2″, 3″, 4″ or more) . . . Hi-Yield, Inconel, stainless, Hastelloy and all other weldable metals. Extra tangent lengths, reducing ells, and special fittings of all kinds are made best as welded-type fittings.

THE WORLD'S MOST COMPLETE LINE OF WELDING FITTINGS . . . sold through stocking distributors from coast to coast.

MIDWEST

Write for NEW brochure
SEAMLESS AND WELDED-TYPE
FITTINGS, No. 60-C

PIPING COMPANY, INC.
1450 South Second Street *St. Louis 4, Missouri*



Yoder Tube Mills speed tailpipe production at AP Parts Corporation

The AP Parts Corporation (Toledo, Ohio), world's largest producer of replacement mufflers and tailpipes, uses 2 YODER Tube Mills to produce more than *300* ft. of 1¾", 1⅞" and 2" tubing per minute.

According to Mr. John Grindle, Plant Engineer, the two-man operated YODER Mills are vital to the production of the entire plant. "YODER Tube Mills earn their keep daily. They are easy to set up, maintain and operate . . . the welds are clean and uniform. We depend on them for constant quality, high production and minimum downtime".

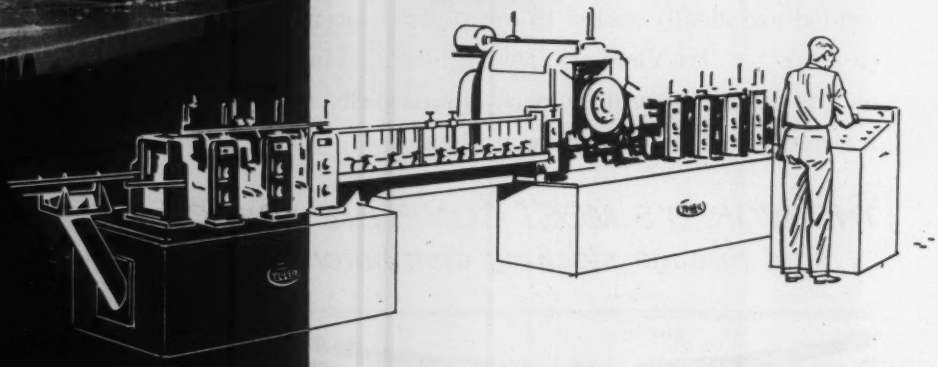
The YODER Tube Mills at AP Parts exemplify the production economies and dependability of all YODER-built equipment, whether it be Pipe and Tube Mills, Cold Roll-Forming Machinery or Slitting Equipment.

If your products require ferrous or non-ferrous pipe or tubing, from ¼" to 26" diameters, there is a YODER Mill designed to produce it economically, accurately and efficiently.

THE YODER COMPANY

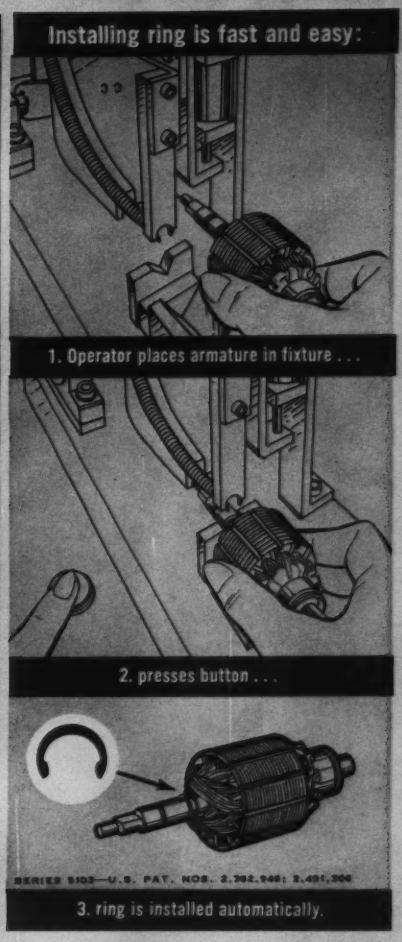
5499 Walworth Avenue • • Cleveland 1, Ohio

For complete information on YODER Pipe or Tube Mills . . . write for the fully illustrated, 88 page YODER Tube Mill Book . . . it is yours for the asking.



ENGINEERING **YODER** MANUFACTURING

PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES
ROTARY SLITTING LINES


Installing ring is fast and easy:
1. Operator places armature in fixture . . .
2. presses button . . .
3. ring is installed automatically.

Mechanized Truarc ring installation speeds assembly

eliminates costly shimming and gauging operations

Fast, semi-automatic assembly and the elimination of costly production operations are among the benefits Leece-Neville Co., Cleveland, Ohio, derives from the use of Truarc retaining rings in the manufacture of its fractional horsepower automotive motors.

Radially-assembled Truarc Series 5103 Crescent® rings—supplied pre-stacked—are used to position and lock the armature in the motor housing. Using the special Truarc pneumatic applicator-dispenser illustrated above, the operator merely inserts the rotor and presses a release button. The ring is installed automatically in a pre-cut groove on the rotor shaft!

The precision manufactured Truarc rings, seated in accurately located grooves, reduce accumulated tolerances from a possible maximum of .184" to .025". Costly, time-consuming shimming operations previously necessary to take up end play are eliminated, together with as many as four gauging operations required to select and place the shims.

The Leece-Neville story is just one example of the way Truarc retaining rings are stepping up production on today's fast-moving assembly lines. These versatile fastening devices simplify design, speed assembly and eliminate rejects. In replacing conventional fasteners, they often improve product performance and reliability. All of these advantages are in addition to substantial cost savings!

Truarc retaining rings come in 50 functionally different types . . . up to 97 different sizes within a type . . . 6 metal specifications and 13 finishes. Special Truarc hand, magazine and automatic applicators and grooving tools make production-line application easy on virtually every type of product. Make sure you have on file the new 16-page Truarc assembly-tool catalog No. AT 10-58. Write for your copy today. And remember Waldes Truarc engineers are always ready to assist you with your special production problems. Write: Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, New York. 9.13

WALDES TRUARC® RETAINING RINGS

Waldes Kohinoor, Inc., Long Island City 1, N.Y.

TRUARC RETAINING RINGS...THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

©1959 WALDES KOHINOOR, INC.

3 NEW PUMPS

make Worthite your broadest choice for corrosive applications

Worthington has recently added new pumps at the top and bottom of its Worthite* line.

These new sizes mean you can order standard Worthite centrifugal pumps in capacities up to 4000 gpm and heads up to 275 feet.

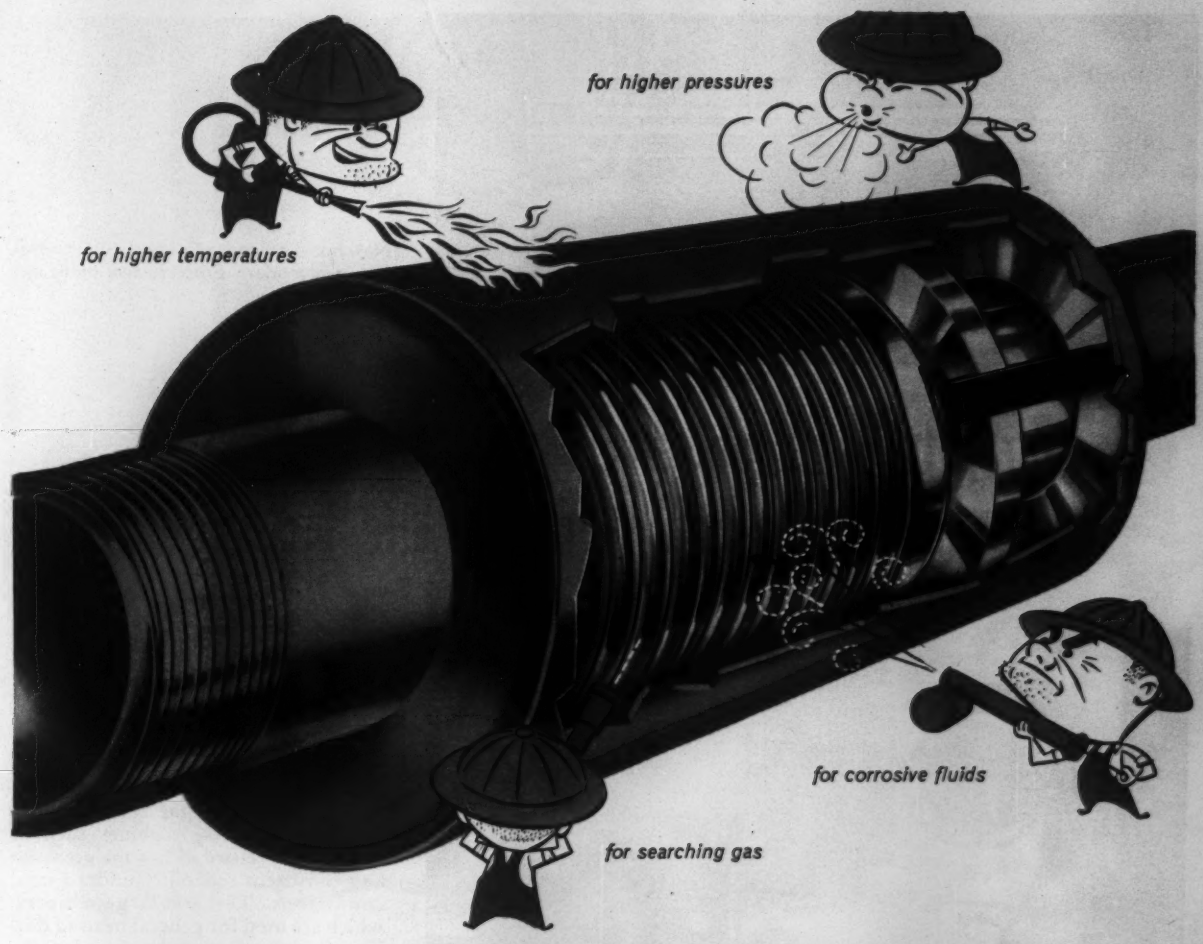
New ⅜" Pump—Available in both frame mounted and Monobloc designs, the ⅜" pump is designed for continuous, 24-hour-a-day service. The rugged frame and shaft is actually the same physical size as the larger ¾" and 1" pumps. All liquid end parts are precision cast. Oil lubricated bearings are standard (although grease lubrication is available.) In short, this pump will give long, trouble-free life and outlast 2 or 3 ordinary units.

New 8" Pump—Of different design than the rest of the line, the new 8" Worthite pump has a twin volute liquid end. A water jacket which serves to either heat or cool the stuffing box area is an integral part of the stuffing box head. The pump can be disassembled from the rear without disturbing the volute, suction head or piping. Separate supports for frame and liquid end facilitate the disassembly.

For the name of your nearest Worthington distributor consult the Yellow Pages. Or write to Worthington Corporation, Section 20-13, Harrison, New Jersey.

*Worthite is a registered tradename for a high nickel, high chromium, molybdenum alloy steel. This "super" stainless steel is available only from Worthington.

WORTHINGTON



FLEXONICS MODEL HS EXPANSION COMPENSATOR NOW IN STAINLESS STEEL FROM TIP TO TIP!

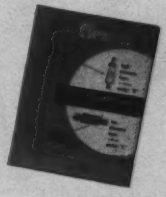
Another important *first* from Flexonics! The original high-pressure, heavy-duty Expansion Compensator is now available entirely of stainless steel—to handle pipe expansion under conditions of higher pressure, higher temperature, corrosive fluids, chemicals and gases.

Screwed, welding, or flanged ends; heavy-duty two-ply Flexonics bellows; positive anti-torque design; and protective shroud . . . all are of stainless steel, to absorb up to 2" pipe expansion under corrosive conditions, at working pressures up to 175 p.s.i., temperatures up to 750°F. Pipe sizes ¾" to 3".

Inch for inch, this is your simplest, lowest-cost way to take up pipe motion under difficult operating conditions. Completely packless, it never needs maintenance. Designed to outlast the piping system you install it in. Also Model H—carbon steel construction with stainless steel bellows; and Model HB—all bronze.

Make Flexonics Expansion Compensators a cost-cutting part of your next piping job.

Write for informative and helpful Catalog No. 205.



EC-140

Flexonics
corporation

In Canada: Flexonics Corporation of Canada, Brampton, Ont.

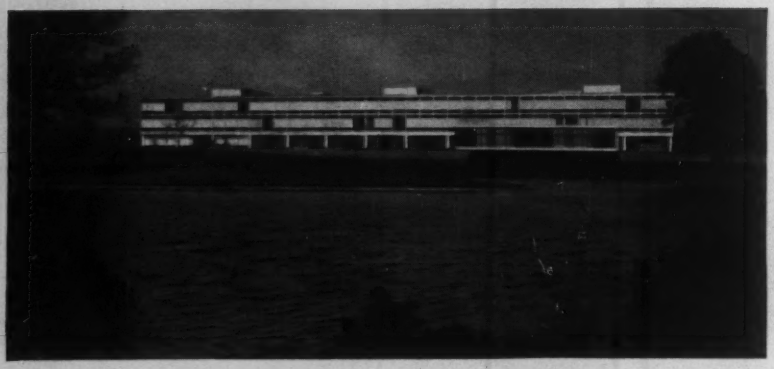
EXPANSION JOINTS | METAL HOSE | SYNTHETIC HOSE | BELLOWS | AERO/SPACE COMPONENTS

A SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

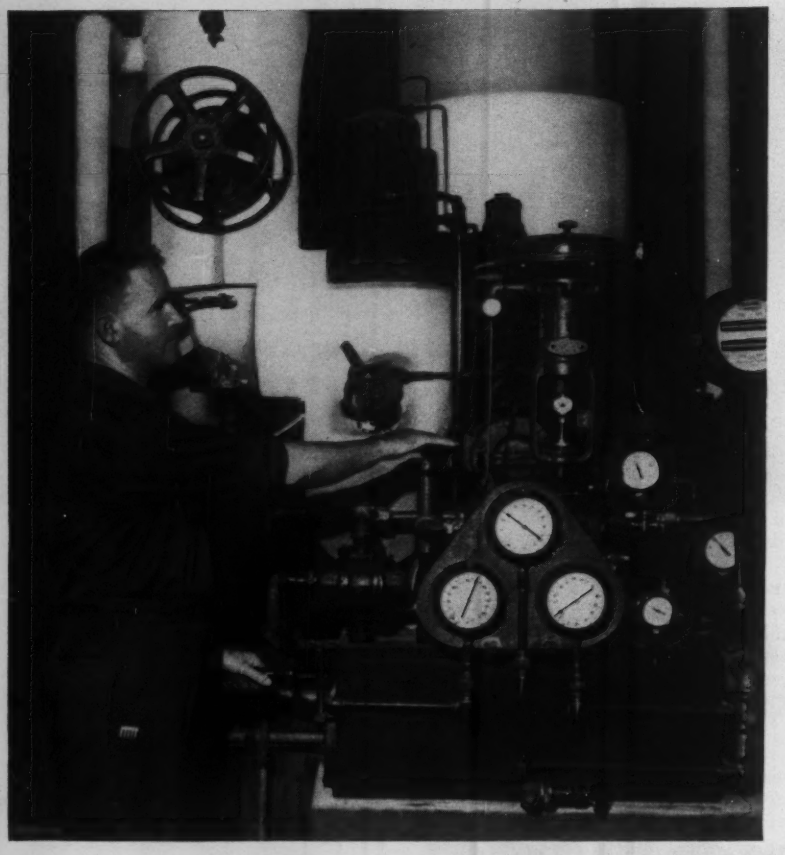
FLEXONICS CORPORATION
1305 S. Third Avenue
Maywood, Illinois

Please send me my personal copy of Flexonics Catalog 205, including full information on using Flexonics Expansion Compensators to absorb pipe movement.



New home office for Connecticut General Life is a modern structure five miles out in the country.

Terry turbines power air-conditioning system at new Connecticut General Life building



One of two 870-hp, 3970-rpm Terry turbines built to drive the refrigeration compressors.

The new home office of the Connecticut General Life Insurance Co., in suburban Hartford, represents the best in contemporary architecture as well as construction techniques and materials.

In keeping with the careful planning evident throughout the project, two Terry turbines were selected to drive the York centrifugal refrigeration compressors. Terry turbines such as these have a record of low maintenance and consistent reliability under varied conditions. The steam generators, which are used for general heating during the winter months, furnish the power to operate the turbines. This provides an economical and dependable air-conditioning setup.

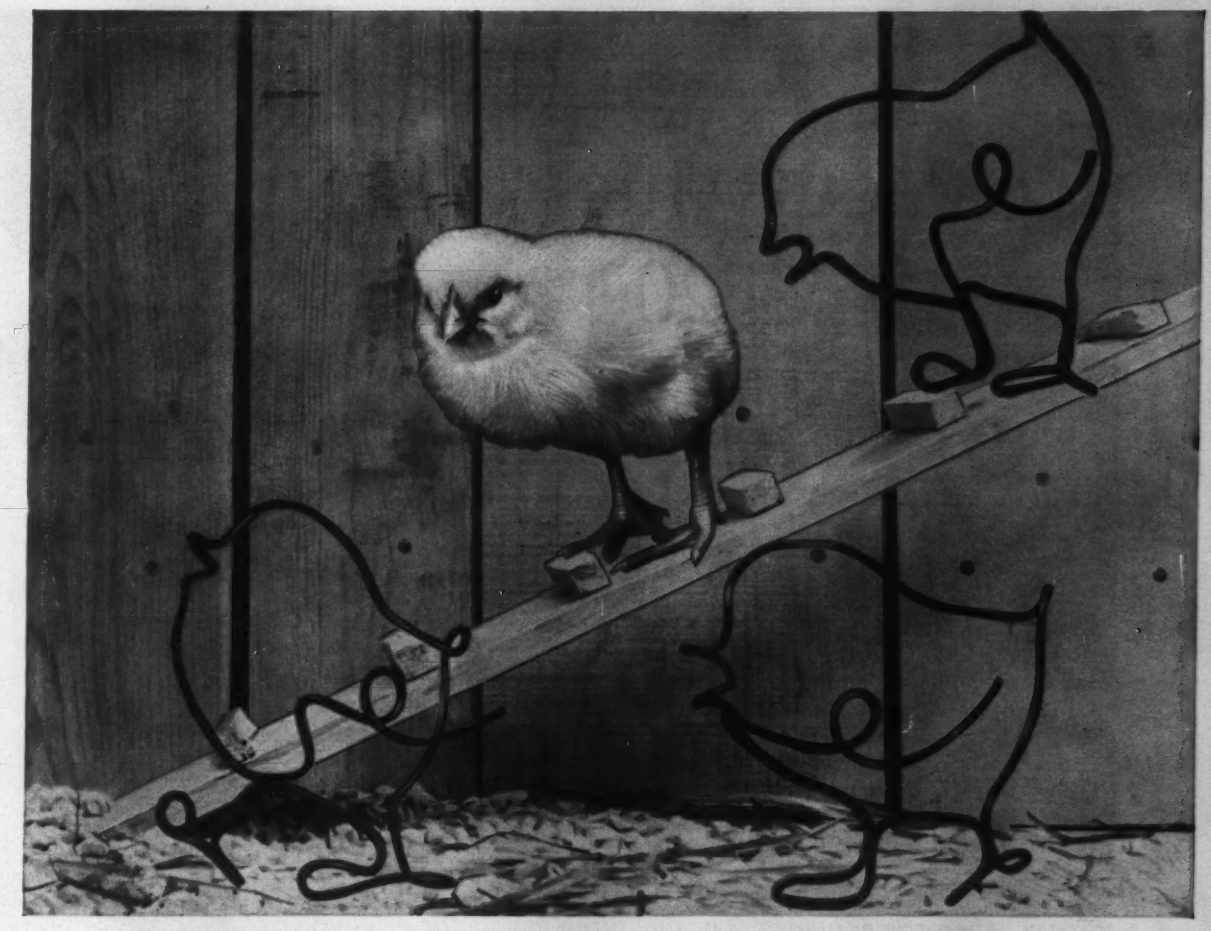
The steel and glass building accommodating 2500 employees overlooks New England farmland. It is furnished with modern equipment, to step up the efficiency of clerical work. Other amenities: lounges, game rooms, cafeteria, bowling alleys, barber and beauty shops, variety store, medical department.

If you are planning an air-conditioning system, perhaps you, too, should consider steam-turbine drive. Write for detailed information about the advantages of turbines for your specific requirements.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

W-1213



Bundy can mass-fabricate practically anything

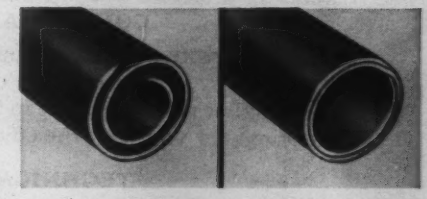
Bundyweld®—the original double-walled steel tubing—is ideal for everything from simple bends to complex shapes

The old adage, "Don't count your chickens before they hatch," is a good one . . . but it rarely applies to Bundy. That's because, no matter how complex your tubing problem, you *can* count on Bundy for the perfect solution.

Bundy engineers and designers are backed by years of experience in the mass-fabrication of steel tubing. And they are available to you at any stage of product development for time- and money-saving suggestions. Their key: Bundyweld®!

Bundyweld steel tubing is double-walled, copper-brazed, stronger, with higher bursting and fatigue strengths. That makes Bundyweld the safety standard in small-diameter tubing—and a wise choice for a wide variety of tubing applications! Covered by Government Spec. MIL-T-3520, Type III.

So, when you want to talk tubing, talk to the leader—Bundy! Phone, write, or wire Bundy Tubing Company, Detroit 14, Michigan.



Bundyweld is the original tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.

Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ½" O.D.

There's no substitute for the original Bundyweld Tubing.

BUNDY TUBING COMPANY

HOMETOWN, PA. • DETROIT 14, MICH. • WINCHESTER, KY.

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, AND ITALY

Coal cuts fuel costs $5200 a year

Hinsdale High School uses just 1450 tons of coal a year, saves on fuel and handling costs

When Hinsdale Township High School, Hinsdale, Ill., was designed, an engineering survey on the cost of steam generation was conducted simultaneously. (Steam would be used principally for heat, hot water, swimming pool and laundry.) The survey dictated the selection of coal for lowest fuel costs and a completely modern coal-fired plant was designed for maximum efficiency and economy. Today, outstanding features of this coal burning plant are: one-man operation, economy in labor and fuel, mechanical coal and ash handling and low maintenance costs. The decision to use coal saves this relatively small coal-burning plant $5200 in fuel costs annually over the nearest competitive fuel.

COAL IS LOWEST COST FUEL

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% more steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

CONSULT AN ENGINEERING FIRM

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns —familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

TECHNICAL ADVISORY SERVICE

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

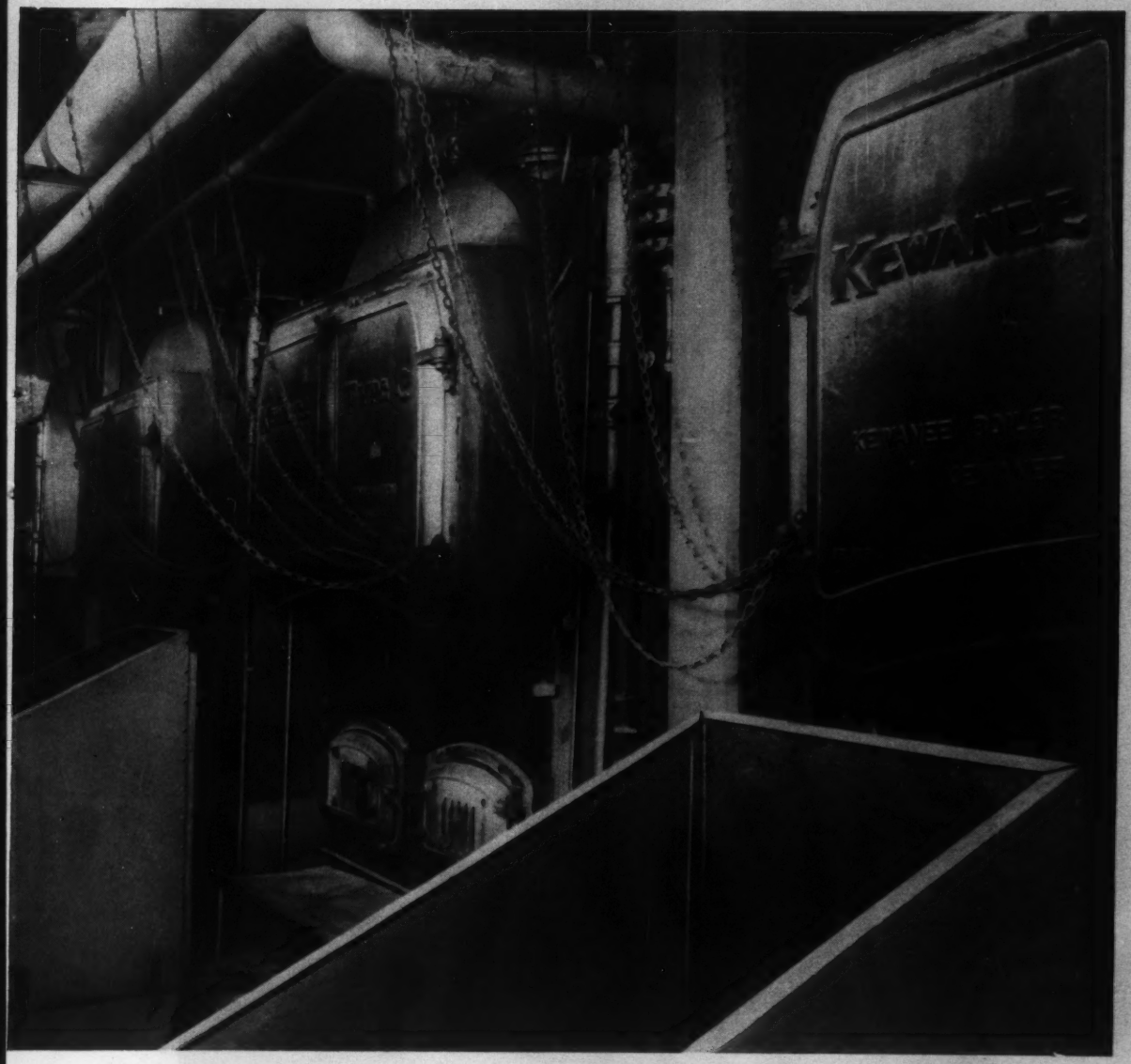
BITUMINOUS COAL INSTITUTE

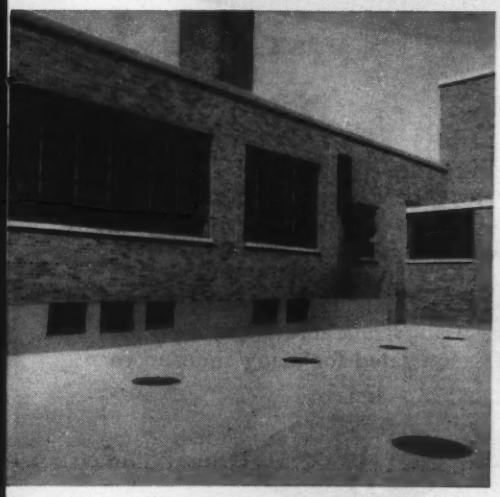
Department ME-04, Southern Building, Washington 5, D. C.

See our listing in Sweet's Files: A-30J/Bi; PE-4a/Bi; IC-18/Bi

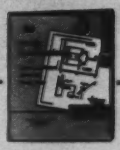
Three boilers in foreground are Kewanee Type C firebox units, rated at 20,000 sq. ft. radiation, fired by Iron Fireman single-retort stokers, with 1000 lb/hr coal feeding capacity. At rear is Fitzgibbons Type D firebox unit rated at 29,000 sq. ft. fired by Iron Fireman stoker, 1200 lb/hr capacity.

Exterior view of power plant. Coal is gravity fed from trucks through manholes into 600-ton storage bin. It is then moved by Hager screw conveyor to stokers. Ashes move from ash room by Webster bucket conveyor to chute (on right) for disposal.





SEND COUPON FOR NEW BCI PUBLICATIONS
Guide Specifications, with complete equipment criteria and boiler room plans:



ME-04

Bituminous Coal Institute
Southern Building, Washington 5, D. C.

Gentlemen: Please send me:

- ☐ GS-1 (low-pressure heating plant, screw-type underfeed stoker).
- ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker).
- ☐ GS-3 (automatic package boiler for heating and process plants).
- ☐ Case histories on larger plants.

Name_____

Title_____

Company_____

Address_____

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Bonus Life...Bonus Protection

from the Boiler Capital of the World

BONUS LIFE means longer life and less refractory maintenance made possible by Titusville's unique WTP design.

65% Black Surface Tube Area coverage on rear wall. Titusville's increased black surface tube area means less refractory maintenance through longer refractory life (less down-time for replacement) and a faster steamer.

BONUS PROTECTION (solves the H_2SO_4 problem). Most water tube steam generators operate intermittently. When dew point is approached at low fire condition, H_2SO_4 can form quickly in *single casing* boilers. Titusville WTP's *double casing* design (with insulation between) reduces temperature differential. *Result:* formation of H_2SO_4 almost entirely eliminated for many times more casing life.

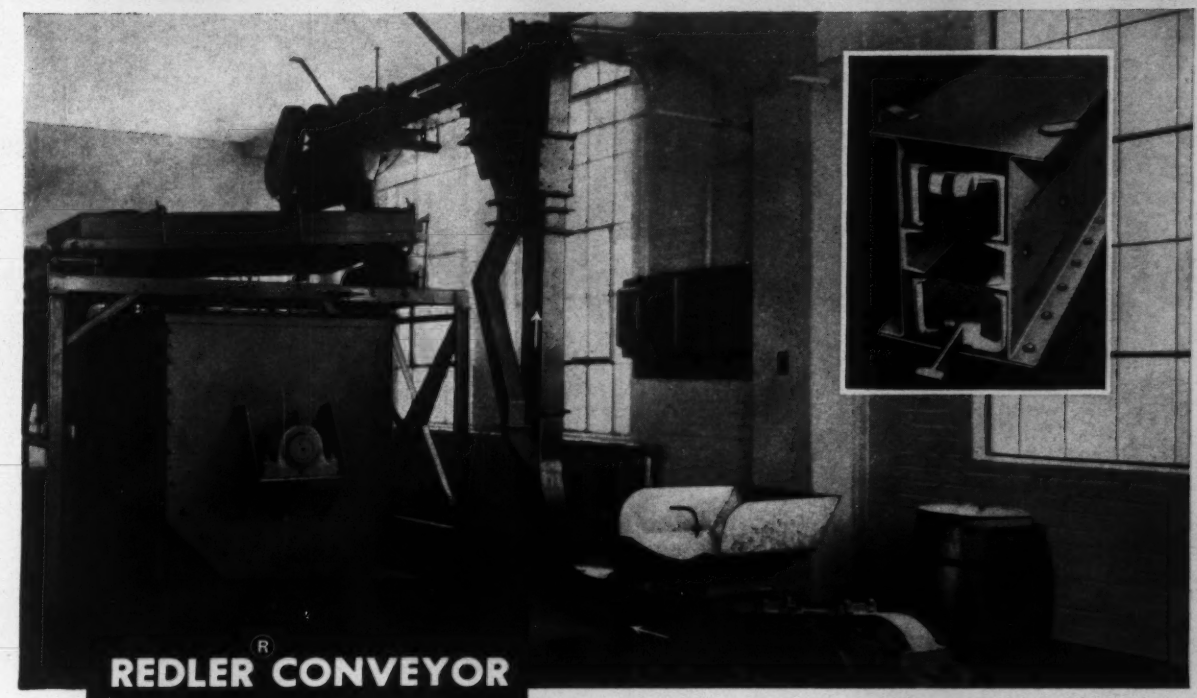
VMA 6979

THE TITUSVILLE IRON WORKS COMPANY
TITUSVILLE, PENNSYLVANIA

Division of Struthers Wells Corporation

For your BONUS LIFE and BONUS PROTECTION, specify WTP from Titusville

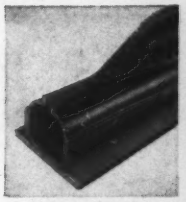
STEPHENS-ADAMSON



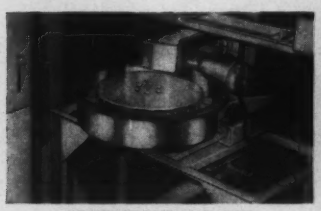
REDLER® CONVEYOR ELEVATORS SPEED EFFICIENCY, LOWER BULK FOOD HANDLING COST

The movement of pulverized, granular, small lump or flaked bulk foods are handled fast, efficiently and at lower cost per ton by STEPHENS-ADAMSON REDLER Conveyor-Elevators. The REDLER Conveyor-Elevator moves material by an EN MASSE action horizontally, vertically, on inclines or around bends without breakage or spillage. All movement is continuous and takes place within totally enclosed, dust-tight, compact casings, permitting large tonnages to be handled in small space. The conveying element consists of a series of U-type skeleton flights which move readily around sprockets and bend corners with relatively low power required at the drive. Skeleton flights may easily be unlocked and replaced without tools. For low handling cost per ton and maximum flexibility, the S-A REDLER Conveyor-Elevator is ideally suited to the requirements of the food industry.

S-A ENGINEERED CONVEYOR PRODUCTS FOR FOOD HANDLING SYSTEMS

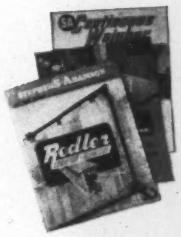


"ZIPPER" CLOSED-BELT CONVEYOR-ELEVATOR BULLETIN 349



CONTINUOUS WEIGHER BULLETIN 958

NATURAL FREQUENCY VIBRATING CONVEYORS BULLETIN 353



REQUEST LITERATURE LISTED ABOVE

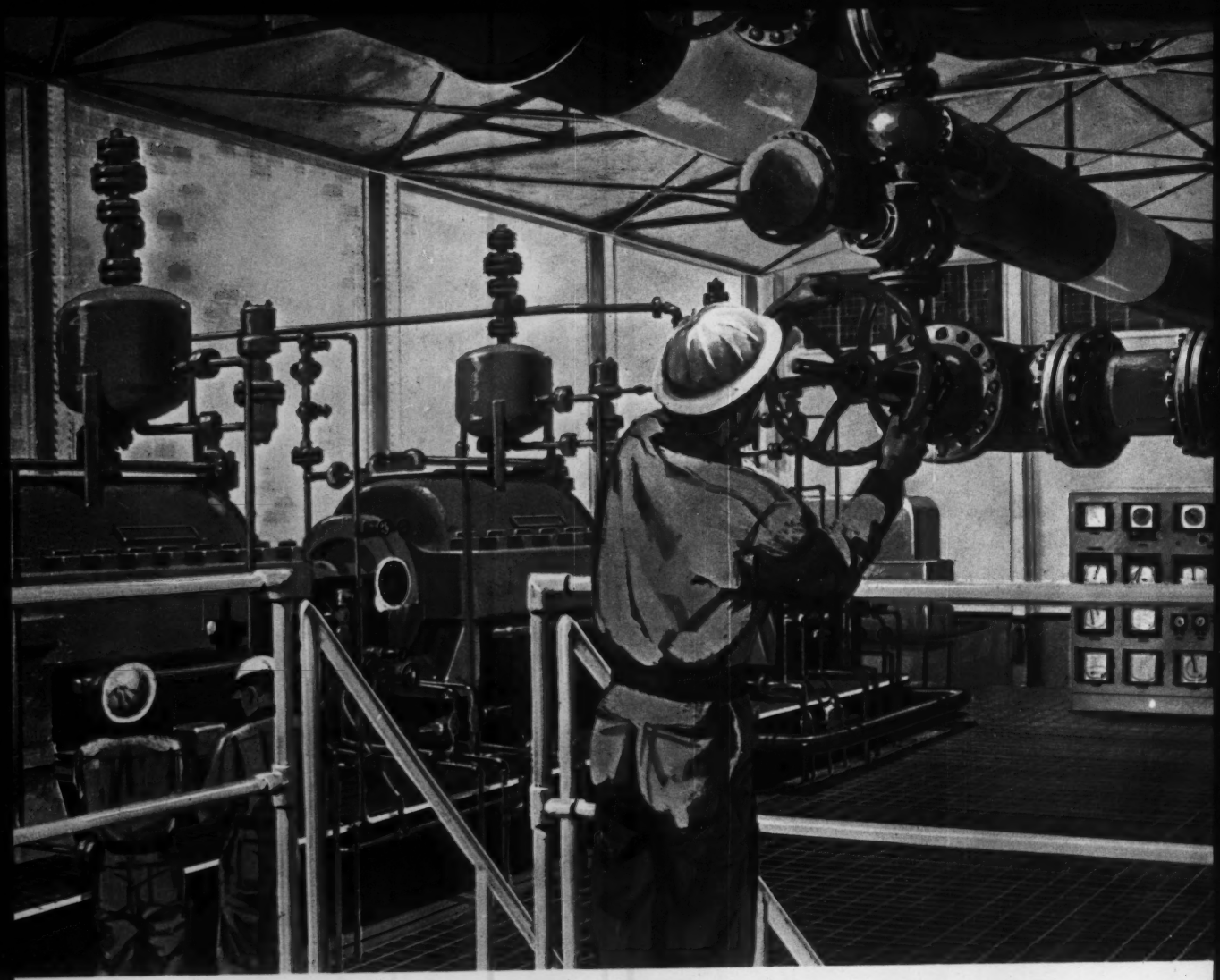
S-A
ENGINEERED BULK HANDLING SYSTEMS
MATERIAL HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
SEALMASTER® BALL BEARING UNITS
SPHERCO® BEARINGS & ROD ENDS

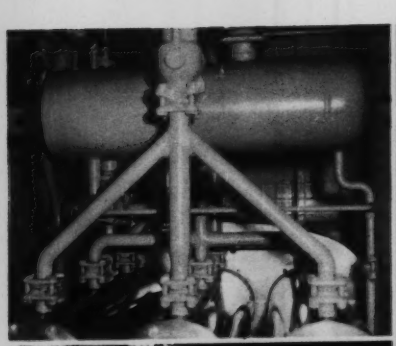
ENGINEERING DIVISION

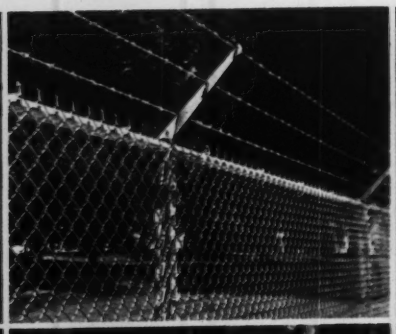
STEPHENS-ADAMSON MFG. CO.

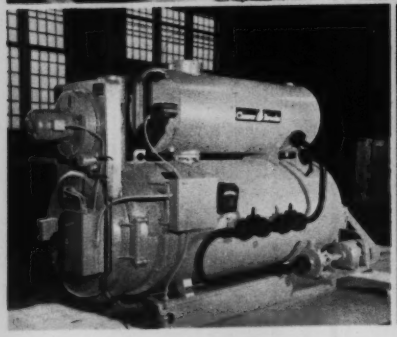
GENERAL OFFICE & MAIN PLANT, 19 RIDGEWAY AVENUE, AURORA, ILLINOIS

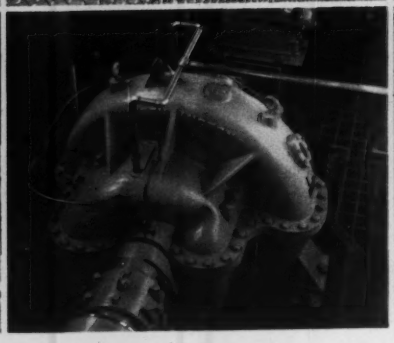
PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

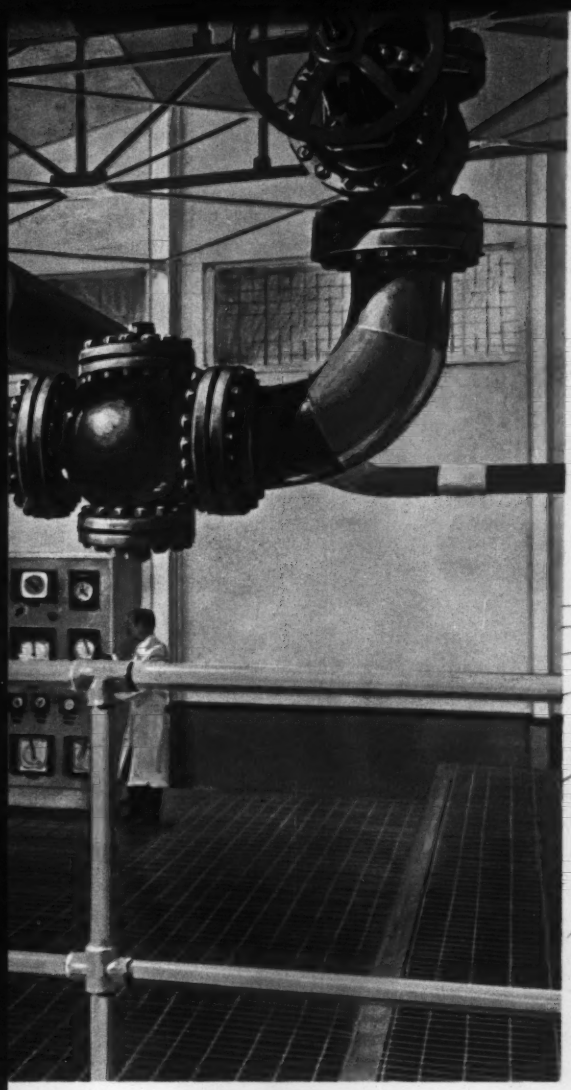












Rust-Oleum

NEW COLOR HORIZONS

System

HERE is a modern, functional *system* that combines four important points. (1) the ability to stop rust, (2) modern color harmony, (3) durability to last and last, (4) ease of application. From machinery, equipment, and structural steel to tanks, steel fences and metal sash – the Rust-Oleum New Color Horizons System can provide lasting beauty in the colors of your choice. Ask your Rust-Oleum Industrial Distributor, together with your Rust-Oleum Factory Specialist, to make a survey of your plant and provide complete recommendations. Rust-Oleum Industrial Distributors maintain complete stocks for prompt delivery in all principal cities of the United States, Canada, and in many countries around the world.

Rust-Oleum, in its various forms, can also save you time and money on problems like these: Heat Resistance, Water Resistance, Chemical Resistance, Coating Galvanized Metal, Speedy-Dry Coatings (less than thirty minutes to dry).

PROVED THROUGHOUT INDUSTRY FOR OVER THIRTY-FIVE YEARS

RUST-OLEUM®

See our catalog in Sweet's.

STOP RUST by applying Rust-Oleum 769 Damp-Proof Red Primer directly over the sound rusted surface

Save time, money, and metal. Brush Rust-Oleum 769 Damp-Proof Red Primer right over the remaining sound rusted surface after scraping and wirebrushing to remove rust scale and loose rust. **Specially-processed** fish oil vehicle penetrates rust to bare metal as proved in radioactive tracing studies.

STOPS RUST!®

Distinctive as your own fingerprint. There are imitations, but only one Rust-Oleum.

Insist upon industry-proved Rust-Oleum. Accept no substitute.

You take the brush! Try a free test sample!

ATTACH TO YOUR LETTERHEAD

RUST-OLEUM CORPORATION
2985 Oakton Street • Evanston, Illinois

At no cost or obligation, please send me:

- ☐ New full-color catalog on New Color Horizons System and specialized Rust-Oleum systems, including color charts and applications.
- ☐ FREE TEST SAMPLE of Rust-Oleum 769 Damp-Proof Red Primer.
- ☐ Please have your representative contact us to discuss a plant survey.

BOWATERS UTILIZES BY-PRODUCT WASTE AS FUEL

At Bowaters Carolina Corporation, Detroit RotoGrate Stoker, with 6 Detroit air swept spout refuse distributor feeders, installed under Babcock and Wilcox 2 drum single pass steam generator. Steam is produced at 850 psig, 900° F-T.T. Feedwater temperature 300° F. Combustion air temperature is 350° F.

Bowaters Carolina Corporation's new plant at Catawba, South Carolina uses a Detroit RotoGrate Stoker to burn bark refuse under a steam boiler. The installation is designed to produce 200,000 pounds of steam per hour when burning bark alone.

Costly waste disposal measures, which in years past were common to pulp mill operation, have been eliminated.

Provision is made for future firing of coal either in conjunction with bark or separately, and 275,000 pounds of steam will be produced with this combination. Peaks of 300,000 pounds of steam are anticipated.

Oil and gas burners in the furnace walls are presently used for auxiliary firing if refuse fuel is not available in sufficient quantity to supply the demand for steam.

Versatile in their ability to burn a broad variety of fuels . . .

DETROIT ROTOGRATE STOKERS

. . . have an established reputation for efficient performance.

8417

DETROIT STOKERS COST LESS: Cost equals initial investment plus upkeep plus production losses due to equipment outage. *The total is less with Detroit.*

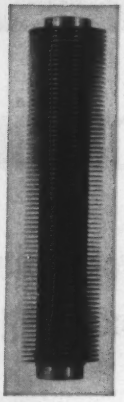
DETROIT STOKER COMPANY

Main Office and Works, Monroe, Michigan • District Offices or Representatives in Principal Cities

NEW LOW SILHOUETTE FANAIRE AIR-COOLED CONDENSERS

ALWAYS FACED RIGHT —NO MATTER WHAT THE WIND DIRECTION

No need to position circular Fandaire Air-Cooled Condensers to meet prevailing winds. Just set it anywhere for easiest piping.



Exclusive Aimco fintube design provides high-heat dissipating efficiency for circular Fandaire condensers.

Here's the newest, most advanced air-cooled condenser on the market—Fandaire! This modern low silhouette condenser is engineered around a new high-heat dissipating fintube of exclusive design and manufacture. In operation, the entire spiral of fintubing is surrounded with a circle of swiftly moving cool air for highest cooling efficiency. Every degree in temperature drop is fully utilized as this circular design captures the wind from *any* direction, regardless of placement or location. A powerful fan pulls cool air in and pushes warm used air up and away. Fandaire's constant gravity tube drainage gives continuous movement to condensate.

With its low, clean-lined silhouette, Fandaire does not detract from the general architectural effect of the building. And weighing ⅓ less than conventional installations, the Fandaire usually can be positioned where needed, without guy wires or extra bracing. Savings in piping and installation alone may be considerable.

Where there is a problem of architectural compatibility, or of cost or performance, chances are the new Fandaire Air-Cooled Condenser is the best solution. Engineered in sizes from 3 to 120 tons per unit, there is a Fandaire model for practically all single or multiple installations. Get complete information today.

YUBA

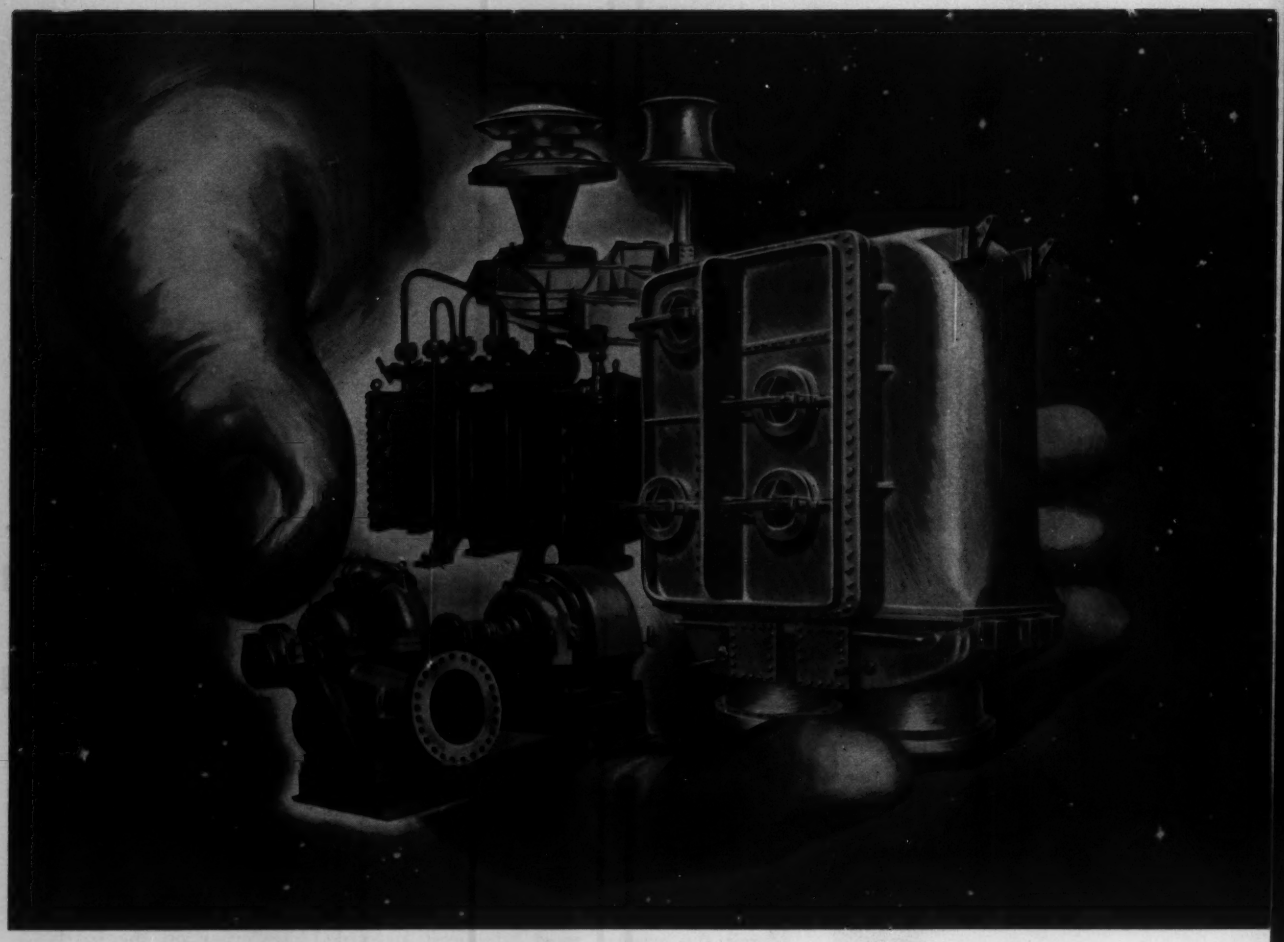
specialists in circular air-cooled condensers

YUBA-AIMCO DIVISION

801 West 21st Street, Tulsa, Oklahoma

YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Atlanta • Buffalo • Chicago • Cleveland • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Seattle



NEW! ...the combination of

the combination of these two equipment in designing or procuring components for

Write today for this brochure:
The New Story of
C. H. Wheeler Mfg. Co. / Griscom-Russell Co.
c/o C. H. Wheeler Mfg. Co.
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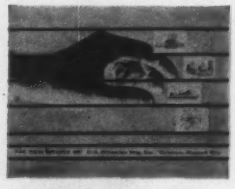
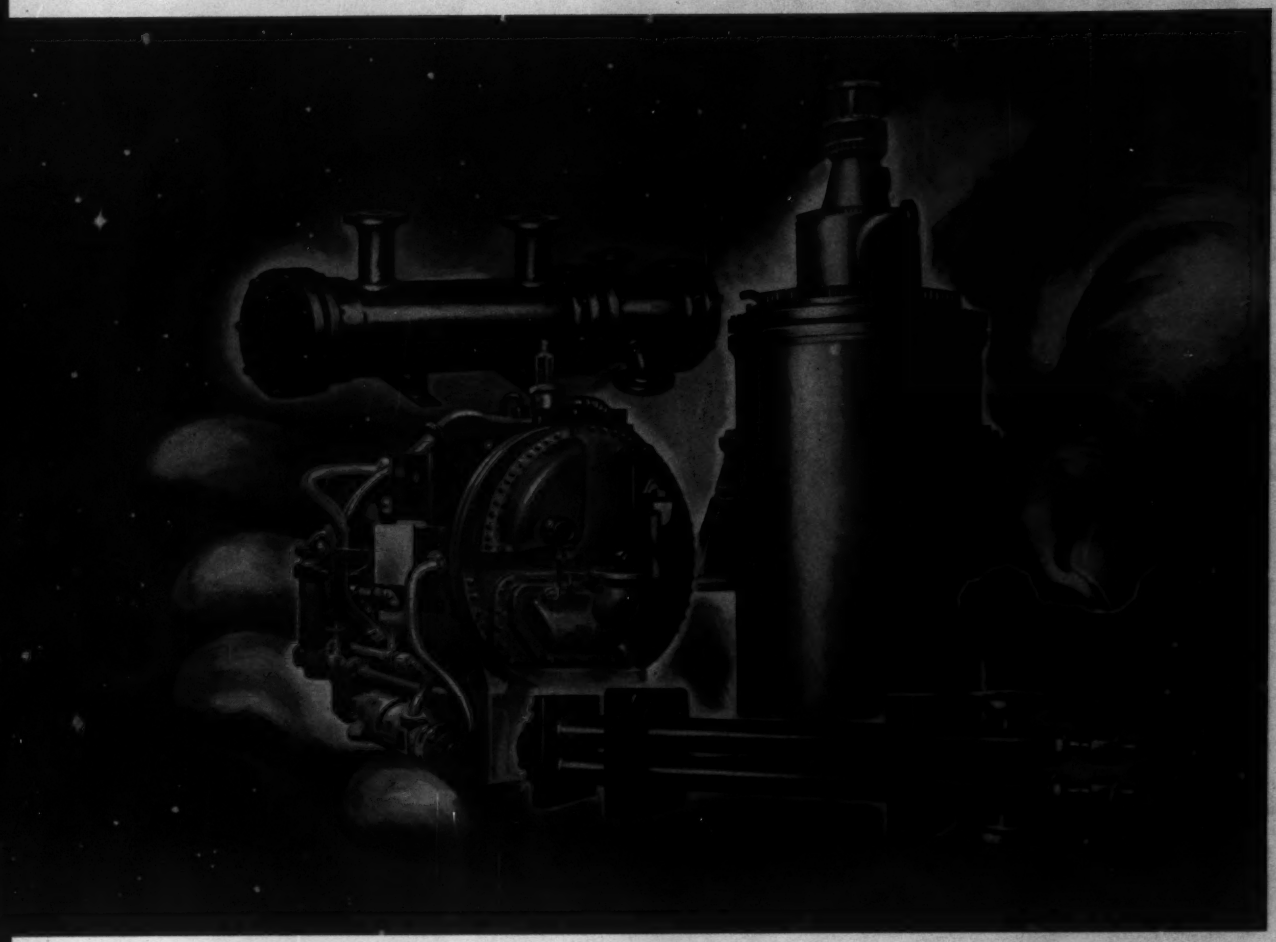


among the many components offered are: Condensers, Ejectors, Heat Exchangers — Bare Tube, Extended Surface Heat Exchangers,



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lines offers important savings for management and engineering staffs engaged a variety of applications in power plants, marine, process and nuclear systems.

C. H. Wheeler Manufacturing Company, with 71 years' experience manufacturing condensers, ejectors, pumps and other components for the power, marine, process and nuclear industries, and Griscom-Russell, with 92 years' experience in the heat exchange field, are uniting to create an important pool of experience, products and services unmatched in industry today. The advantages offered by this combination are improved and increased selection, distribution and service, resulting in substantial savings for the current and potential customers of both companies.

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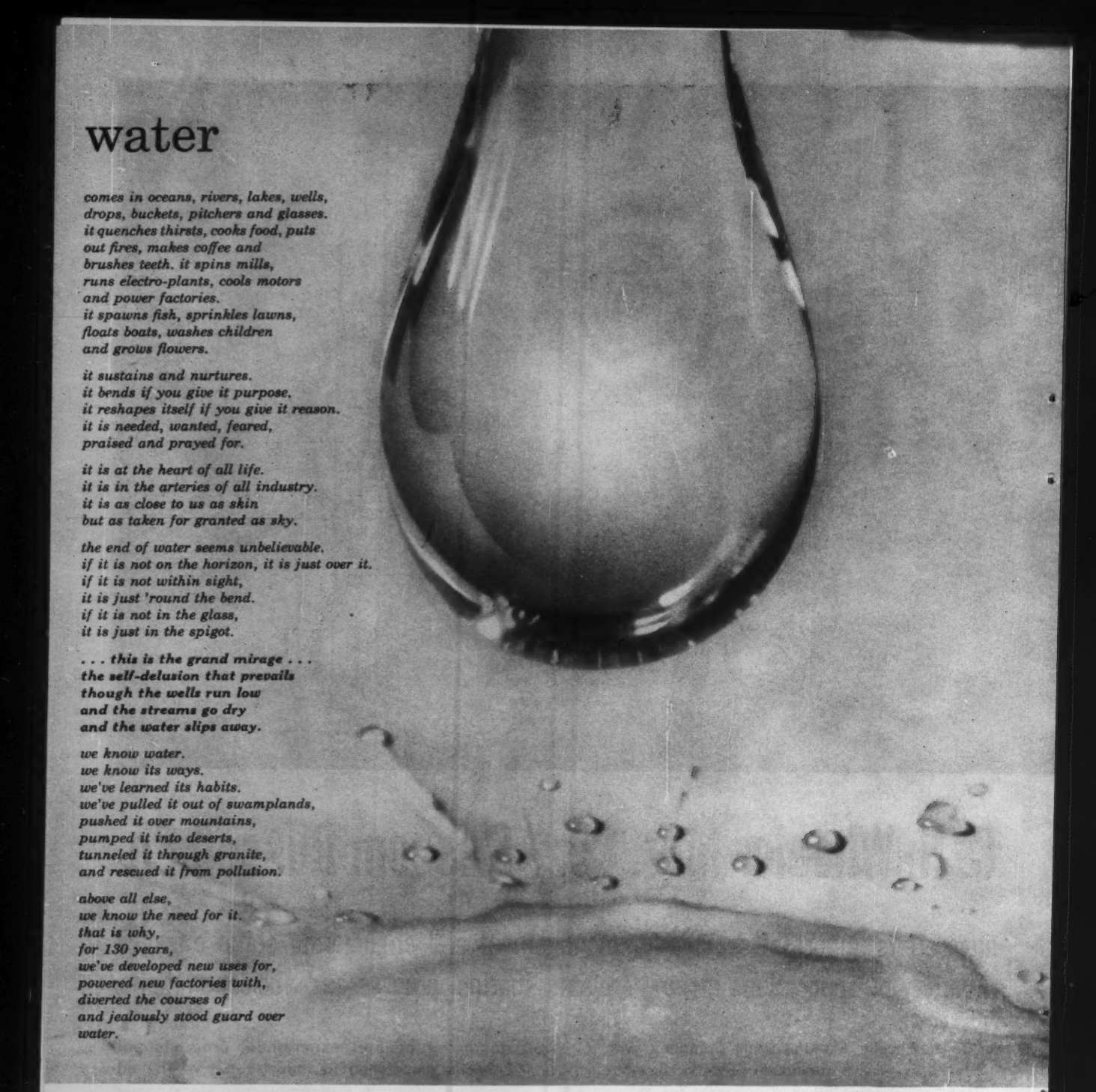


water

comes in oceans, rivers, lakes, wells,
drops, buckets, pitchers and glasses.
it quenches thirsts, cooks food, puts
out fires, makes coffee and
brushes teeth. it spins mills,
runs electro-plants, cools motors
and power factories.
it spawns fish, sprinkles lawns,
floats boats, washes children
and grows flowers.

it sustains and nurtures.
it bends if you give it purpose.
it reshapes itself if you give it reason.
it is needed, wanted, feared,
praised and prayed for.

it is at the heart of all life.
it is in the arteries of all industry.
it is as close to us as skin
but as taken for granted as sky.

the end of water seems unbelievable.
if it is not on the horizon, it is just over it.
if it is not within sight,
it is just 'round the bend.
if it is not in the glass,
it is just in the spigot.

. . . this is the grand mirage . . .
the self-delusion that prevails
though the wells run low
and the streams go dry
and the water slips away.

we know water.
we know its ways.
we've learned its habits.
we've pulled it out of swamplands,
pushed it over mountains,
pumped it into deserts,
tunneled it through granite,
and rescued it from pollution.

above all else,
we know the need for it.
that is why,
for 130 years,
we've developed new uses for,
powered new factories with,
diverted the courses of
and jealously stood guard over
water.

Fairbanks, Morse

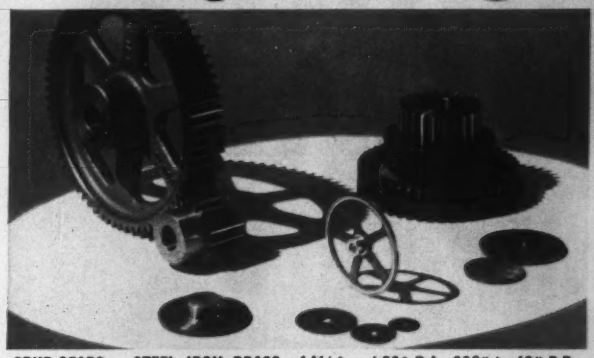
A MAJOR INDUSTRIAL COMPONENT OF FAIRBANKS WHITNEY CORPORATION, NEW YORK

No other manufacturer makes pumps for such a variety of hydraulic applications as Fairbanks, Morse. If it's liquid . . . if it flows . . . we make the pumps that move it . . . at low cost per gallon . . . in sizes from 200 gph to 800,000 gpm, and to 3000 psi . . . for every industrial need.

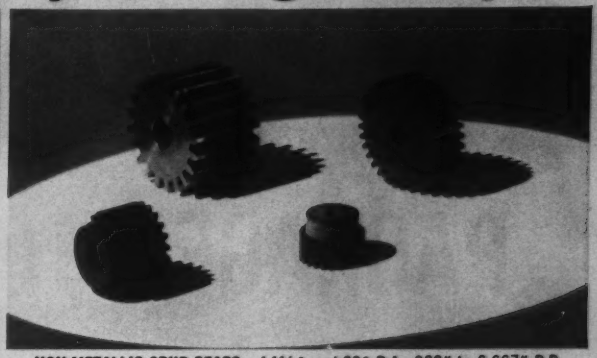
Our pumps . . . our generators and controls . . . our new rotary compressors . . . our drive toward better ways to de-salt ocean water . . . the potential of our advance Research & Development Center in Beloit . . . our lead position in the field of Hydrodynamics . . . all of these equip us to serve you.

Send for our brochure—"Hydrodynamics." Please write to Mr. Robert W. Kerr, President, Fairbanks, Morse & Company, 600 South Michigan Ave., Chicago 5, Illinois.

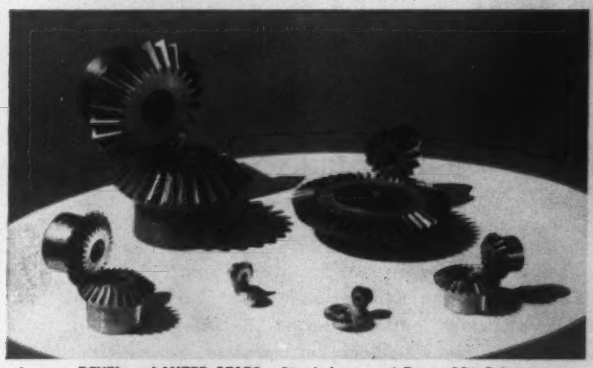
Design around gears you can get today



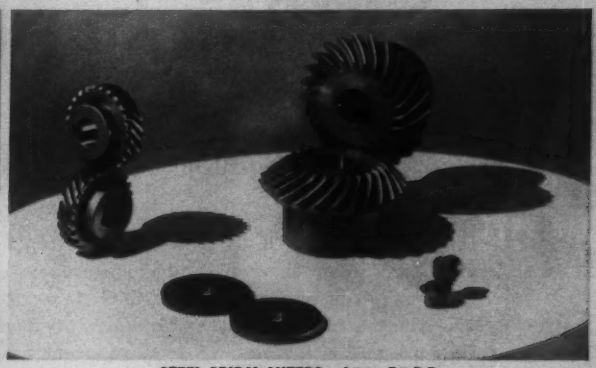
SPUR GEARS — STEEL, IRON, BRASS 14½° and 20° P.A. .208" to 40" P.D.



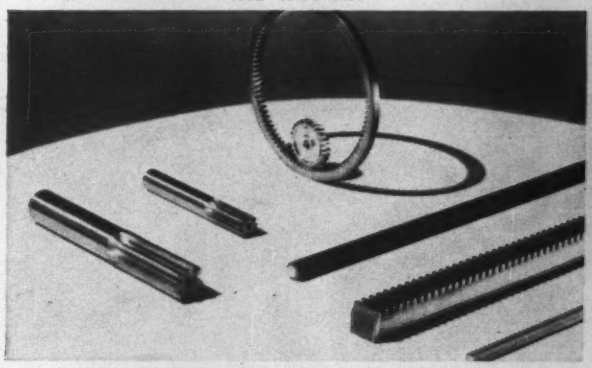
NON-METALLIC SPUR GEARS 14½° and 20° P.A. .938" to 6.667" P.D.



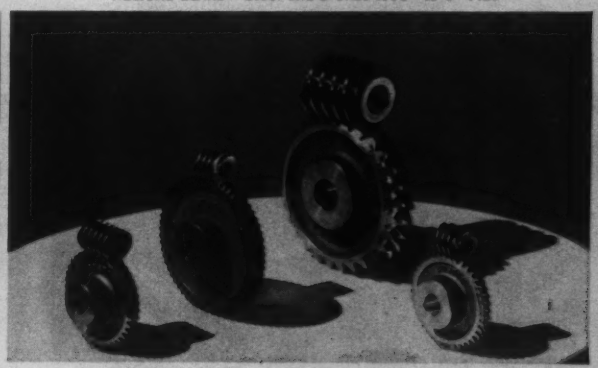
BEVEL and MITER GEARS Steel, Iron, and Brass 20° P.A. .312" to 14" P.D.



STEEL SPIRAL MITERS 1" to 5" P.D.
HELICAL GEARS Steel and Bronze .333" to 6" P.D.



RACK • PINION WIRE Steel and Brass 14½° and 20° P.A.
PINIONS • INTERNAL GEARS



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FROM STOCK
AT FACTORY PRICES

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— *STANDARDIZATION PAYS*

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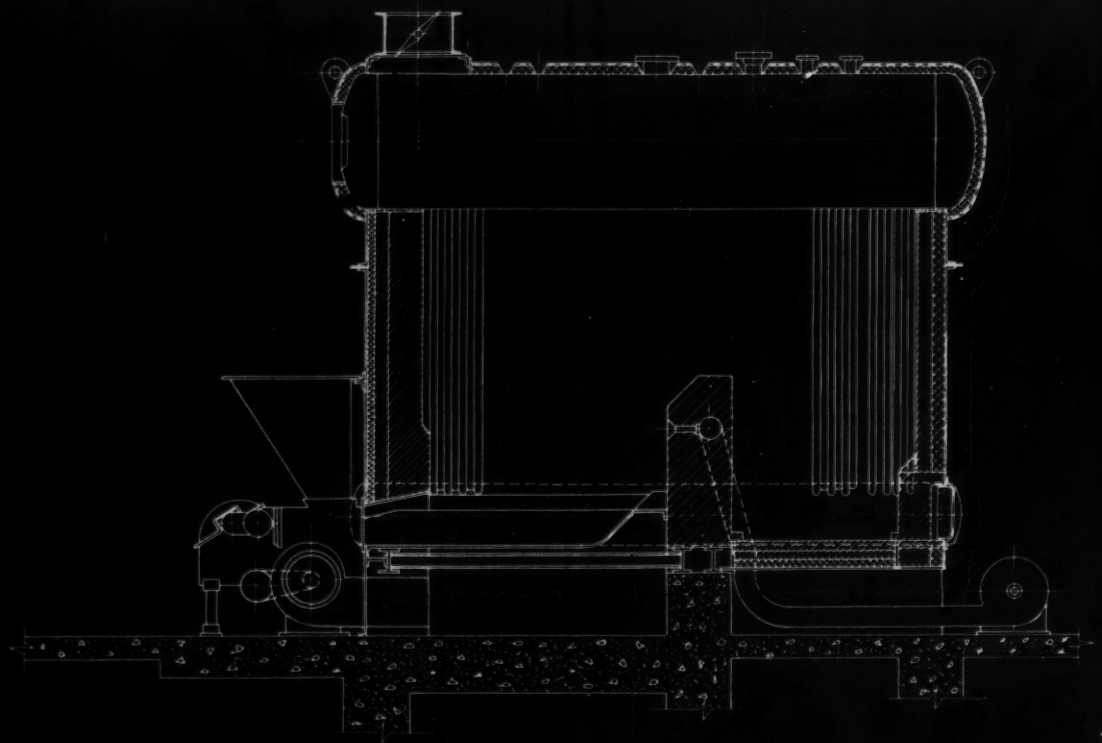
you can take full advantage of the fuel situation with

WICKES

PACKAGE STOKER-FIRED STEAM GENERATORS

Designed and built to WICKES recognized standard of excellence, engineered to WICKES high standard of efficiency

These stoker-fired WICKES generators are compact, package water tube boilers, custom-engineered to your exact steam generating requirements. Semi-automatic in operation and convertible from stoker-fired to either gas or oil fired, these WICKES generators are built to the highest standards of workmanship to give you the same efficiency of operation that you have come to expect from all WICKES-built boilers. They are built in a variety of designs to meet size, space and fuel conditions. For complete information on these WICKES stoker-fired units as well as the complete line of WICKES water tube steam generators, ask the WICKES sales representative nearest you to call . . . offices in principal cities*.



TYPE A

TYPE S-3

TYPE A

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BOILER CO., SAGINAW 13, MICHIGAN

RECOGNIZED QUALITY SINCE 1854

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DIVISION OF THE WICKES CORPORATION

CARBORUNDUM'S TECHNICAL INFORMATION ON UNUSUAL REFRACTORIES

Data sheet

How to choose materials for

WEAR RESISTANCE

Choice of a material to give optimum wear resistance requires knowledge of type of wear (e.g. abrasion or erosion), effect on different materials, and presence of such factors as load, corrosion, thermal shock etc.

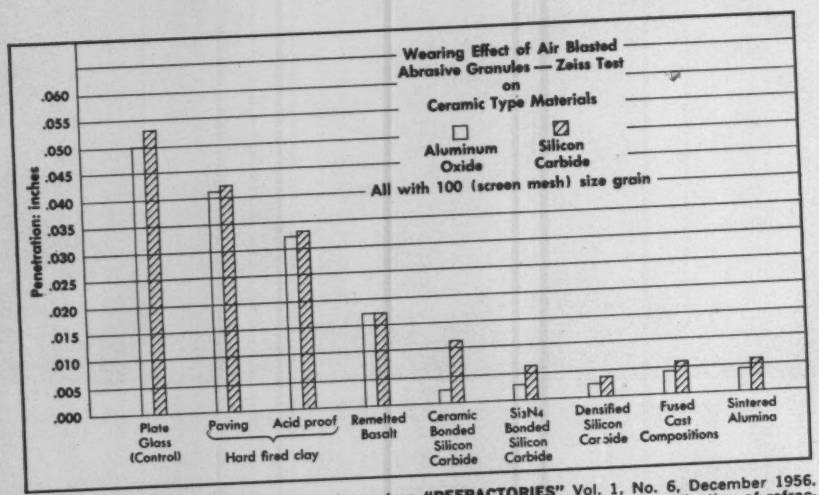
The two basic types of wear (examples shown at right) are (1) impingement of fine solids entrained in air, gas, or other fluid and (2) direct sliding of a solid mass across a surface. Effects may be erosion, primarily of the bond, thus dislodging the harder body granules; minute progressive bond fracture due to impact; or chipping, gouging or grinding of monolithic materials.

Refractories manufactured by Carborundum from electric furnace materials — such as silicon carbide and alumina — offer excellent wear resistance (see chart). Moreover, they are chemically inert, resistant to spalling, and have superior load-carrying capacity. As a result, they have found extensive use in dust collectors, gas scrubbers, transfer pipelines, hydro-cyclones, etc.

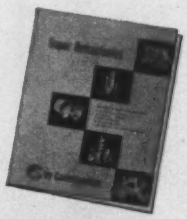
Carborundum's accumulated experience and data may help solve your wear problems. Feel free to ask for any assistance.

Abrasion by more than 2,500,000 pounds of sinter dust in 7 years has been resisted by the CARBOFRAX® silicon carbide lined cone of this primary dust collector. By comparison, other brick in the scroll and in the course between scroll and cone have been worn back to the shell, in one area after only 5 months.

Skids of CARBOFRAX® silicon carbide lasted 156 weeks under heat and the abrasion of 6¾" x 8" brass billets in this gas-fired extrusion mill furnace. Steel skids averaged only 5 weeks life.



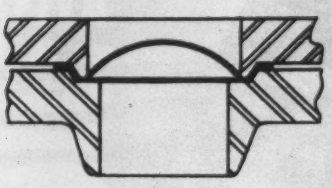
Information adapted from Chart 1, Carborundum **"REFRACTORIES"** Vol. 1, No. 6, December 1956. This bulletin, containing extensive technical information on the properties and application of refractory-type products, is published bi-monthly. Complimentary subscription on request.



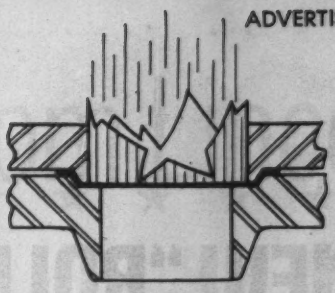
Write today for your free copy of "Super Refractories by Carborundum." The address: Dept. ME-40, Refractories Div., Perth Amboy, N. J.

For engineered refractories, count on **CARBORUNDUM®**

ADVERTISEMENT



The BS&B Safety Head provides a leak-tight assembly under normal operating conditions.



When pressure reaches the rated rupture point of the disc, instant release is provided through full orifice diameter by the outward bursting of the rupture disc.

For Chemical And Design Engineers . . .

An Advanced Approach To Pressure Release Or Transfer

Although BS&B Safety Heads have been employed for over-pressure protection in closed pressure systems in numerous industries for more than 25 years, it is only recently that they have come into their own as a pressure *transfer* device.

Recent metallurgical and engineering developments, as well as improved manufacturing procedures, have made the BS&B Safety Head the lightest weight, most accurately calibrated pressure release device ever developed. A typical Safety Head consists of a metal rupture membrane secured in mounting flanges. There are no moving parts.

How It Functions

The rupture membrane, or disc, is a purposely designed "weak spot" in the pressure chamber or system. When the internal pressure rises to the rated rupture point of the disc, the disc bursts to provide an instantaneous full-throated relief opening.

This outstanding feature is most advantageous when applied to pressured systems where ignition or exothermic reaction during a given process causes abnormal pressure rise in seconds or milliseconds.

Well Suited To Processing Applications

The application and design of Safety Heads is continually being expanded. They have found wide use in such diversified fields as Food and Chemical Processing, Aircraft and Missile Propulsion, Oil and Gas Production and Processing, Air Conditioning and Refrigeration, Electrical Power Generation and many others.

As an example . . . visualize the rupture disc as a seal to retain a fluid under pressure within a chamber until a given critical pressure had been reached, or until actuated (burst) by a surge of pressure developed within seconds or milliseconds. The pressurized fluid is thus discharged into another chamber where contact with another component in the process will result in ignition, or in a desired chemical reaction.

As a different application of the same basic device, the rupture disc could serve as a signalling device . . . or to retain pressure to a pre-determined point whereupon it would then be actuated by an explosive squib or primacord.

If acids, caustic or other corrosives are present in the process, BS&B Safety Head rupture discs may be obtained with one of several impervious and/or dielectric coating materials such as Teflon, Kel-F, etc. Certain conditions can also be met through use of various metals in the rupture disc itself, such as stainless steel, aluminum, silver, platinum or special alloys.

Infinite Design Variations Possible

BS&B Safety Heads have been manufactured in sizes ranging from ⅛" to 44" in exposed diameter of the rupture disc and in pressure ratings as low as 5 psi and as high as 100,000 psi. Mounting flanges can be supplied from any suitable metal or alloy.

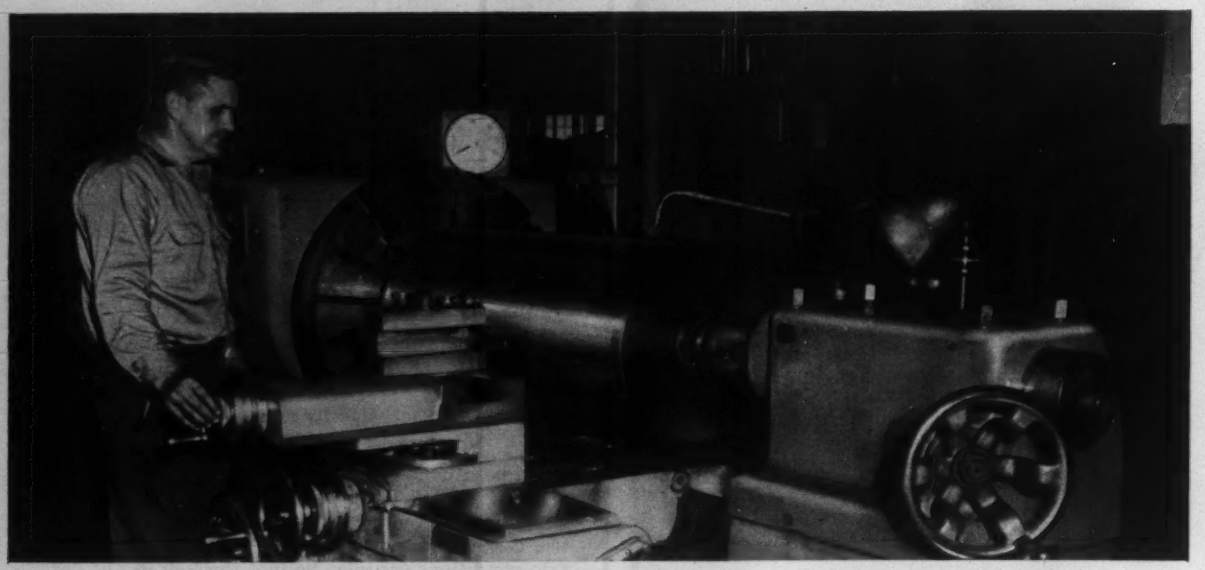
Uses Limited Only By Your Imagination

New and unusual pressure relief requirements involving corrosives, elevated or sub-zero temperatures, pulsating pressures, alternate pressure and vacuum, pressure cycling, or even low to high pressure shock are constantly being solved by the BS&B Safety Head.

If you need overpressure protection or have a pressure transfer requirement calling for a device that will provide instantaneous pressure release, be sure to consider the BS&B Safety Head. It may very well be your answer. Contact your nearest BS&B sales office or agent, or the Safety Head Division Headquarters in Kansas City.

BLACK, SIVALLS & BRYSON, INC., Safety Head Division, Dept. 2-FQ4
7500 E. 12th Street, Kansas City 26, Missouri

A NEW "ROLL" FOR OLD GLORY!



ACIPCO CENTRIFUGALLY SPUN ROLL USED IN PRINTING NEW 50-STAR FLAG

Here is an interesting application for ACIPCO centrifugally spun steel tubing. The above view shows an ACIPCO Type 1025 steel roll — 19" in diameter and 44" in length — being machined prior to copper plating. The roll was subsequently engraved with the 50-star pattern, and then utilized for printing multiple reproductions of our new flag on fabric.

Wherever tubular steel applications exist . . . ACIPCO spun steel tubes serve. Completely equipped to produce a wide variety of centrifugally spun and statically cast products, ACIPCO can serve your requirements more efficiently and economically because all its facilities are "under one roof."

For expert consultation on centrifugally spun tube applications in your field . . . call on ACIPCO.

VERSATILE ACIPCO CENTRIFUGALLY SPUN STEEL TUBES

SIZE RANGE
Lengths up to 40 feet have been produced to meet modern machinery requirements. O.D.'s from 2.25" to 50"; wall thicknesses from .25" to 4".

ANALYSES
All alloy grades in steel and cast iron, including heat and corrosion resistant stainless steel, plain carbon steel and special non-standard analyses.

FURNISHED
As cast, rough machined, or finish machined, including honing. Complete welding and machine shop facilities for fabrication.

Write for free illustrated catalog.

ACIPCO
SPECIAL PRODUCTS
DIVISION OF AMERICAN CAST IRON PIPE CO.
BIRMINGHAM • ALABAMA

NEW from Lincoln

Model 83192 Ratchet-Operated Multi-Luber

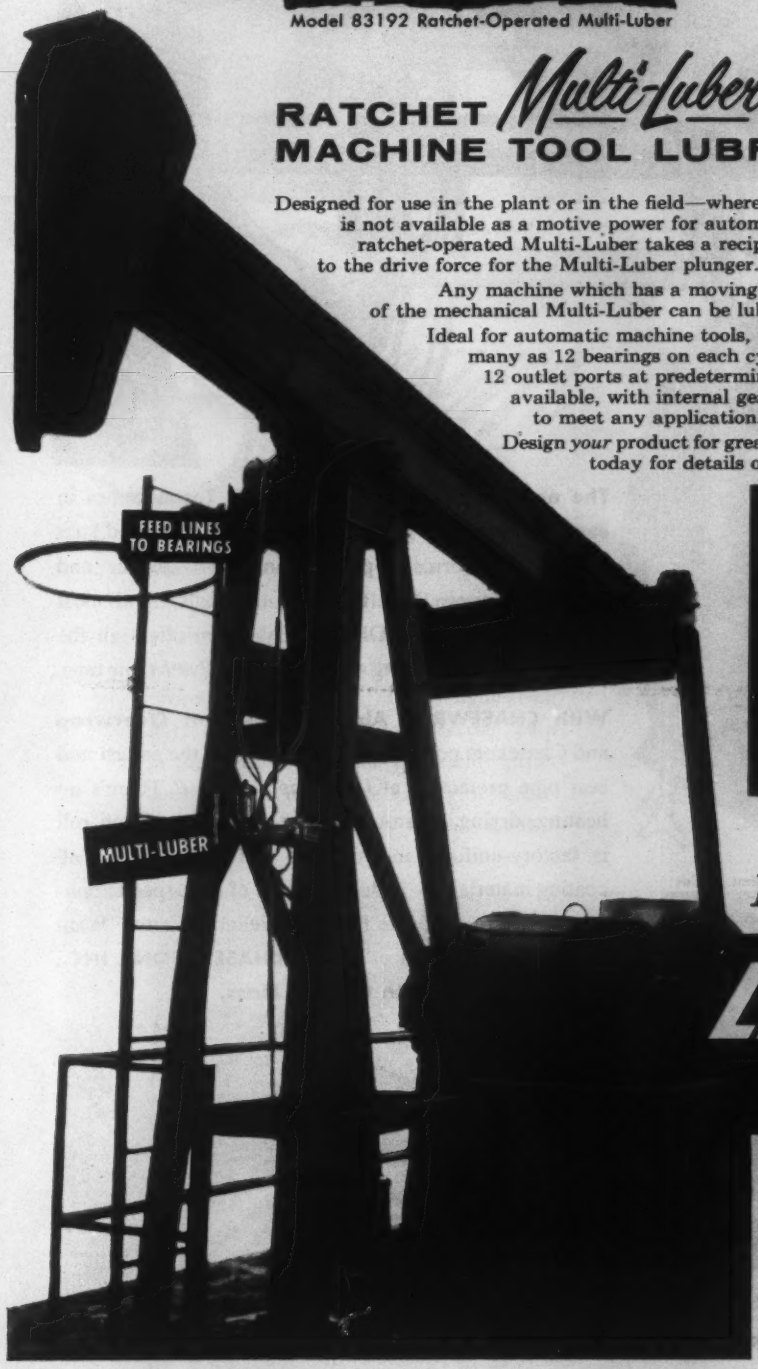
RATCHET *Multi-Luber*® FOR AUTOMATIC MACHINE TOOL LUBRICATION

Designed for use in the plant or in the field—where air pressure, vacuum or electricity is not available as a motive power for automatic lubricant application—Lincoln's new ratchet-operated Multi-Luber takes a reciprocating motion and converts it to the drive force for the Multi-Luber plunger.

Any machine which has a moving part that can be linked to the drive arm of the mechanical Multi-Luber can be lubricated safely, easily and automatically.

Ideal for automatic machine tools, this system will feed lubricant to as many as 12 bearings on each cycle through the measuring chamber and 12 outlet ports at predetermined intervals. There are three models available, with internal gear ratio of 100:1, 50:1 or 25:1 . . . to meet any application.

Design *your* product for greater efficiency and appeal. Send the coupon today for details on Lincoln's Ratchet Multi-Luber System.



Mechanically-operated Multi-Luber System on punch press.

Mail this coupon now!

Lincoln

LINCOLN ENGINEERING CO.
5703-38 Natural Bridge Ave. • St. Louis 20, Mo.

Please send me complete information on Lincoln's new Ratchet-Operated Multi-Luber System.

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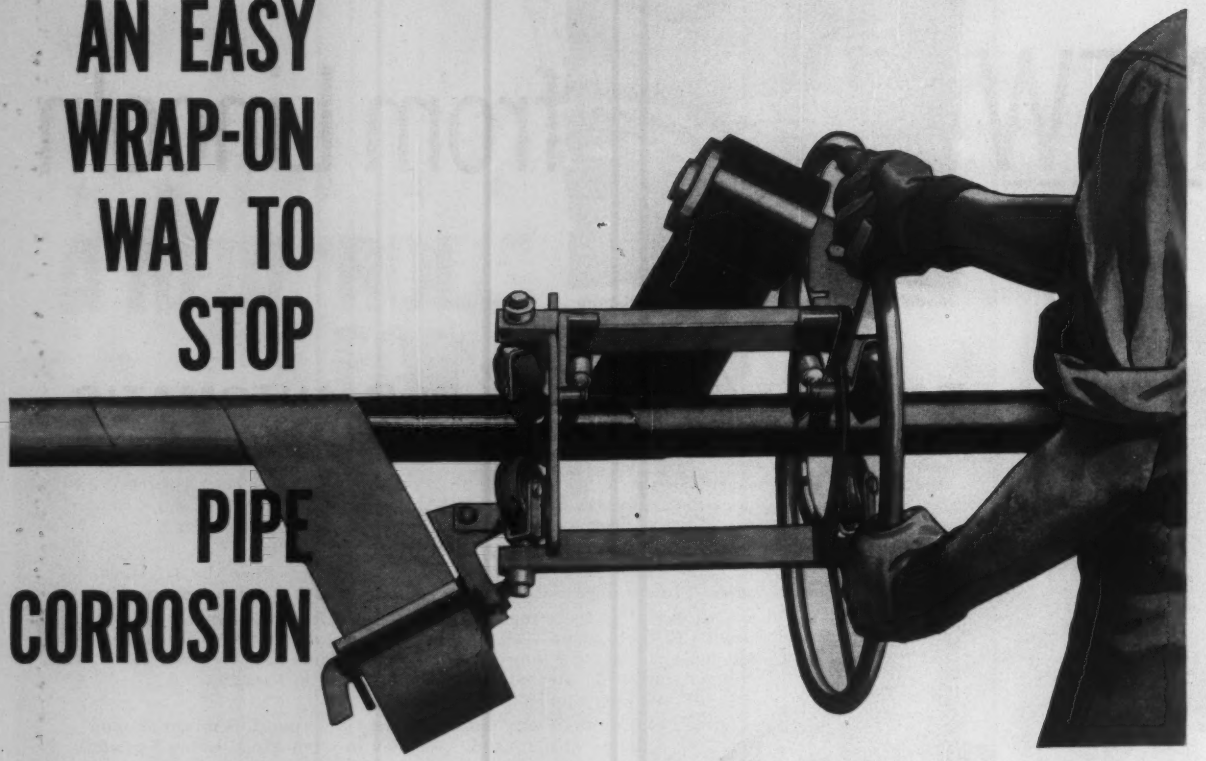
COMPANY _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

AN EASY WRAP-ON WAY TO STOP PIPE CORROSION



Chasekote*

Pressure-Sensitive Polyethylene Tape has an extra-heavy adhesive mass that clings to clean pipe on contact . . . makes a perfect, permanent bond that rustproofs, waterproofs and insulates pipe against all types of corrosion.

Chasewrap*

Protective Overwrap is a tough, wrinkle-free outerwrap that shields against abrasion, wear, and physical damage to the tape. Wraps simultaneously with the tape. Superior to rag and felt warps, yet far lower in cost.

**Trade name of Chase & Sons, Inc., long-famous for protective and insulating tapes for electrical wire and cable*

The new CORR-PREV Pipe Coating Team comes in easy to handle tape form. It goes on pipe faster and lasts longer than corrosion-proof paints. It's cleaner and simpler to apply, too, than hot tar coats. And most important, this new CORR-PREV Team offers all the cost-cutting, pipe-saving advantages of *polyethylene* tape.

With CHASEWRAP Abrasion-Resistant Overwrap and Chasekote polyethylene tape, you get the easiest and best pipe protection at *lowest applied cost!* There's no heating, drying, clean-up or shut-down time. Each roll is factory-uniform in thickness and quality. And all coating materials — including rental of high-speed applicators — are available from one reliable source. Want samples? Specs? Prices? Write **CHASE & SONS, INC., 26 Spruce St., North Quincy, Mass.**

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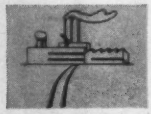
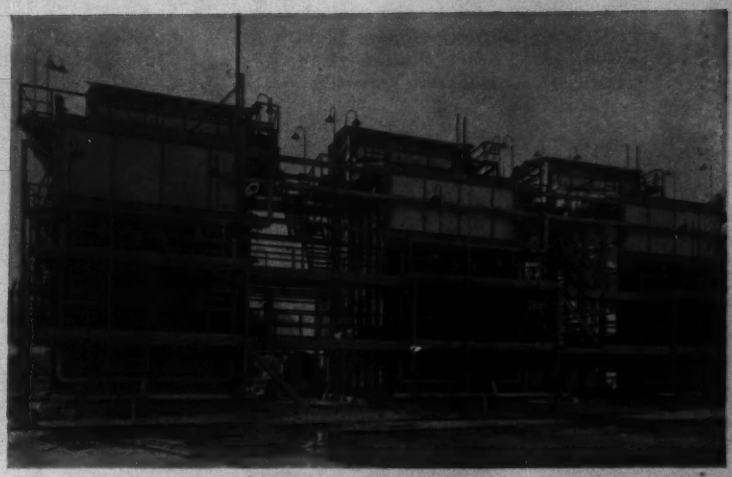
Utility Distribution Systems



Chemical & Industrial Plant Piping

FOR YOUR ELECTRICAL INSULATION PROBLEMS SPECIFY CHASE FRICTION, PLASTIC, RUBBER, NEOPRENE AND BUTYL TAPES



AT LEFT: Installing a 60,000 lbs/hr unit in a brewery

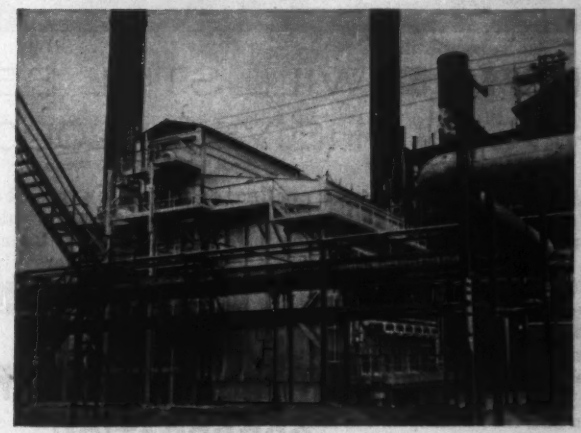
ABOVE: A battery of 125,000 lbs/hr units in a chemical plant

CUSTOM *Steam* GENERATORS by Vogt

Vogt engineering advances can save you money if you have a steam generating problem. Custom-built installations shown, are engineered to assure efficient, dependable steam generation for power, process and heating. Our engineering staff is available to give effective help in the solution of steam generating problems peculiar to a wide variety of operating conditions. Address Dept. 24A-BM.

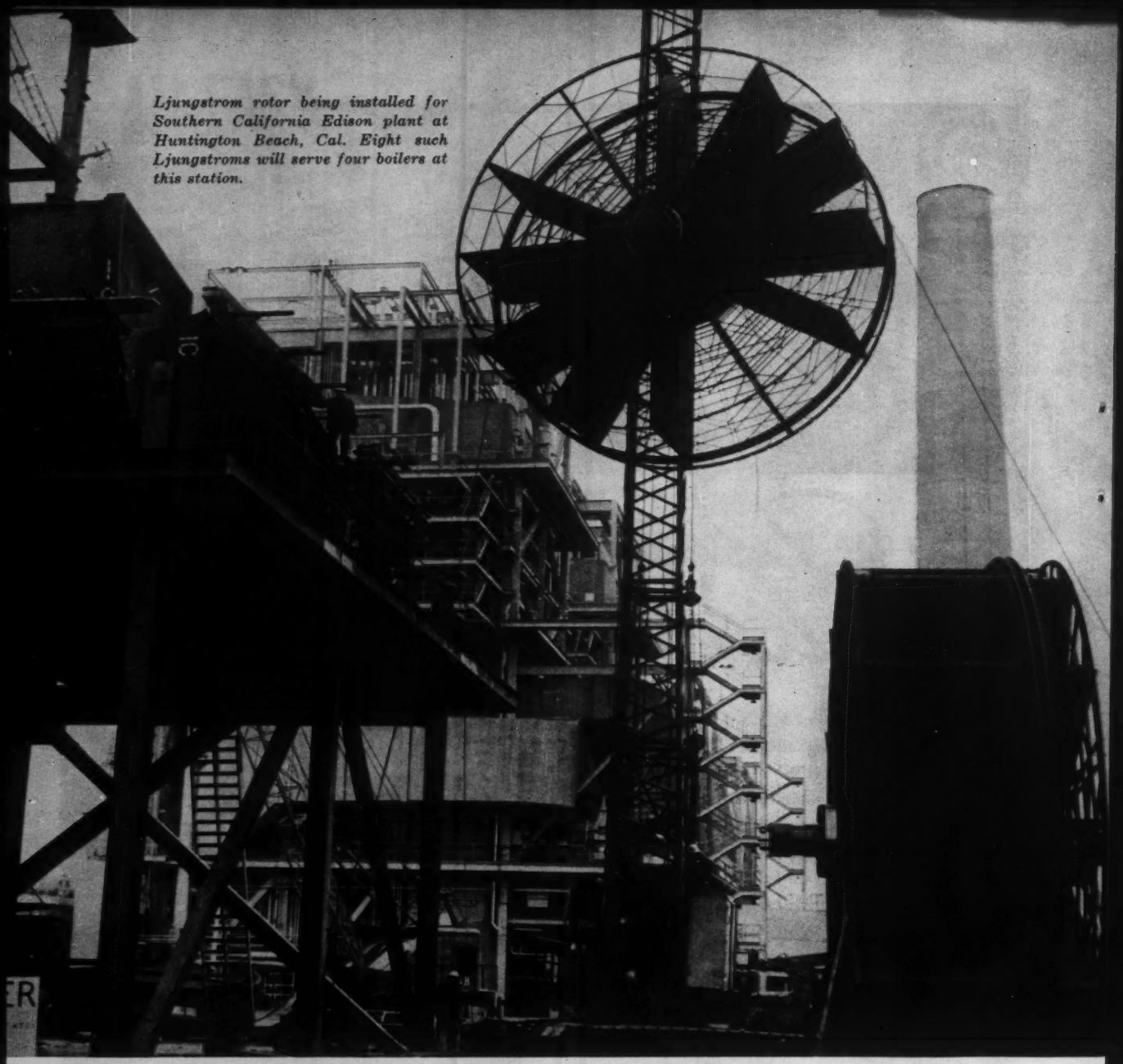
HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati



This 400,000 lbs/hr unit is installed in a leading petroleum refinery

Three 40,000 lbs/hr units serve a medical center



Ljungstrom rotor being installed for Southern California Edison plant at Huntington Beach, Cal. Eight such Ljungstroms will serve four boilers at this station.

AIR PREHEATER SERVICE WILL STILL BE IN EFFECT ON THESE UNITS IN THE YEAR 2000

These new Ljungstrom® Air Preheaters, being installed at Southern California Edison's Huntington Beach Station, will be protected by an unusual service policy, one that guarantees regular inspection by Air Preheater engineers throughout the life of each unit.

There's no terminal date on this service — it's in effect as long as the units are in operation. In fact, Lifetime Air Preheater Service is still helping to keep the first Ljungstrom installation in the U.S. running perfectly, although it's been in operation almost 40 years.

Air Preheater provides first-rate *factory* service too. In one instance, in response to a last-minute decision to replace cold-end elements near the end of a scheduled shutdown, Air Preheater *fabricated and shipped* over 13,000 pounds of heating elements the day after the order was received.

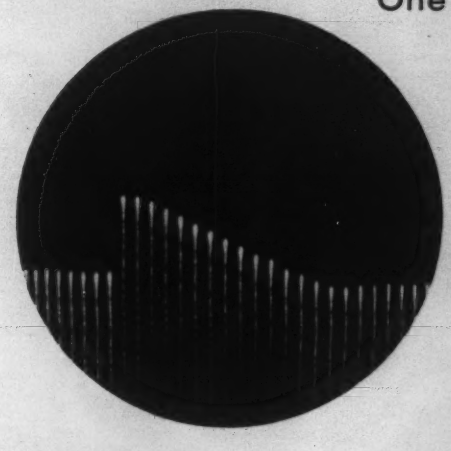
Regular inspection and fast factory service are just two of the advantages Air Preheater offers its customers. Another is expert knowledge of boiler and preheater problems, gained through 35 years' experience. This combination—knowledge of customer problems and a *continuing* interest in them — probably explains why nine out of ten preheaters sold today are Ljungstroms.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

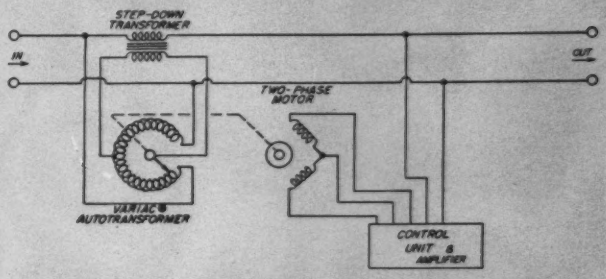
SERVO-OPERATED
Line-Voltage Regulator

50-Ampere, 6-KVA Capacity in a One Cubic-Foot Package



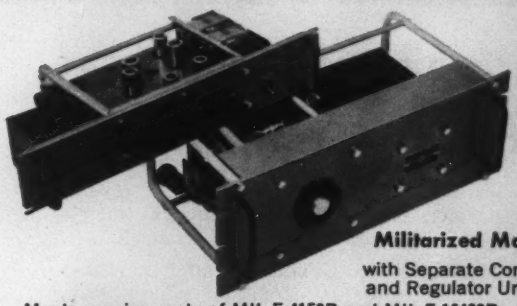
Oscillogram shows peaks of 60-cycle line voltage with sudden 2% change, and subsequent correction by regulator. Change is corrected in 12 cycles (0.2 sec.).

- ★ Handles up to 500 Amperes on Short-Period Overload
- ★ Holds Line Voltage Constant to ±0.25%
- ★ NO Waveform Distortion
- ★ NO Power Factor Restrictions
- ★ NO Relays to Cause Transient Pulses or Chattering
- ★ NO Dead Zones
- ★ Can Be Connected to Handle 10% or 20% Line-Voltage Variations
- ★ Output Voltage Can be Varied ±10% from Nominal Voltage

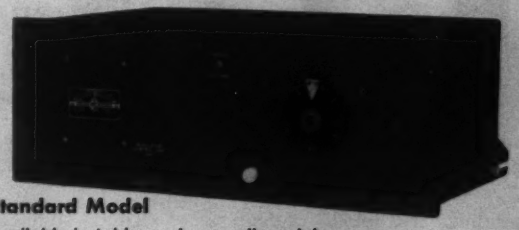


How it works — Any deviation from normal line voltage is sensed by the control unit. The resulting error voltage, amplified by a two-stage balanced amplifier, changes the firing angle of a push-pull thyratron circuit which in turn controls a low-inertia, two-phase servo motor. The motor adjusts a Variac® autotransformer which delivers a correction to the input line voltage through a buck-or-boost transformer.

The control-circuit thyratrons operate continuously and produce two, equal, in-phase motor voltages. Any line-voltage variation causes a proportionate change in phase angle between these two voltages. This change of phase produces a corresponding motor torque, causing correction to take place. Thus, smooth, truly proportional control is achieved, with consequent better accuracy, faster response, and less overshoot (see oscillogram) than is found in regulators using on-off methods.



Militarized Model
with Separate Control and Regulator Units.
Meets requirements of MIL-E-4158B and MIL-E-16400B
for 115-volt, 45-55- and 55-65-cycle lines, **Type 1570-ALS15** . . **$670**
for 230-volt, 45-55- and 55-65-cycle lines, **Type 1570-AHS15** . . **$690**



Standard Model
Available in table, rack, or wall models
for 115-volt, 60-cycle lines, **Type 1570-AL** **$490**
for 230-volt, 60-cycle lines, **Type 1570-AH** **$510**
50-cycle models also available

Two other models available — *A three-phase militarized model for regulation of balanced systems. A regulator for control of 150- to 500-cycle lines (requires 50- or 60-cycle power).*

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Since 1915 — Manufacturers of Electronic Apparatus for Science and Industry

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NEW "BUFFALO" AIR-COOLED CONDENSERS OFFER TROUBLE-FREE OPERATION

Troubles common to most air-cooled condensers are positively eliminated by these field-tested new "Buffalo" units.

"Buffalo" Air-Cooled Condensers are a sound engineering choice for your "problem" air conditioning installations. They are ideal for overcoming such conditions as weight and erection difficulties—high maintenance costs—winter freezing troubles—winter head pressure problems — water shortages — contaminated water — high water cost—high sewer tax—poor drainage.

"Buffalo" Air-Cooled Condensers offer these and many more advantages for air conditioning applications. For full details, call your nearby "Buffalo" engineering representative. Or write us direct.

Easy-to-Install! Shipped as factory-assembled "packages." Lifting eyebolts simplify rigging.

Trouble-Free Operation! Service calls are practically nil, thanks to quality construction and unique control design.

Capacities: 7½ to 100 tons based on 120° condensing temperature, 40° suction, 100° ambient.

Vertical Discharge is unaffected by wind velocity. Holds compressor on line.

Opposed Blade By-Pass Damper Control provides close modulating control not possible with parallel-blade dampers...or with "flooded coil control." Also saves expensive Freon.

Low Silhouette! The No. 1000 unit is only 76" high.

Unit Casings! Heavy-gauge galvanized steel construction for durable long life.

BUFFALO FORGE COMPANY Buffalo, New York

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

MECHANICAL
ENGINEERING

VOLUME 82 • NUMBER 4 • APRIL, 1960

Economic Nuclear Power?

A series of reports representing the first phase of a continuing study to develop long-range plans for the civilian power reactor program has been issued by the United States Atomic Energy Commission. And an all-encompassing series it is. In four parts, the reports not only deal with the . . . . Current Status of Reactor Concepts; Economic Potential and Development Program; and Technical Status, but also with Plans for Development.

It is the latter report which is probably of greatest general interest, for it lists these far-reaching AEC objectives:

1 Reduce the cost of nuclear power to levels competitive with power from fossil fuels in high-energy cost areas of this country in ten years.

2 Assist friendly nations now having high-energy costs to achieve competitive levels in about five years through co-operative programs.

3 Support a continuing long-range program to reduce further the cost of nuclear power in order to increase the economic benefits and extend these benefits to wider areas.

4 Maintain the U. S. position of leadership in civilian nuclear power technology.

5 Develop breeder-type reactors to make full use of the nuclear energy latent in both uranium and thorium, since U-235 alone may not be plentiful enough to meet long-range needs.

Primary attention, says AEC, is being given to the technology required to achieve competitive nuclear power. Hence, prototypes for large central-station power plants figure prominently in this program. But, the Commission points out, this should not be construed as indicating a diminution of AEC interest in, or support of, a small power reactor program directed to achieving economically competitive nuclear power in plant sizes below 50 emw (electrical megawatts). A number of these reactors are now under construction or in the planning stages.

The current program follows a three-phase sequence for developing individual reactor concepts: Construction of reactor experiments or experimental reactors, followed by prototypes, and then by commercial plants. The AEC believes that the reactor experiments should be built and operated by the Commission. Prototypes should be built and operated by publicly or privately owned utilities independently or in co-operation with AEC. Alternatively, prototypes could be built and operated by the Commission. Industry should assume the primary responsibility for large commercial-size nuclear power stations; however, AEC will consider possible assistance on initial plants in various concepts useful for demonstration purposes. AEC believes it important that the large plants, and possibly the prototypes as well, be integrated into utility power grids to demonstrate load factors, dependability, and other operating characteristics.

Experimental and prototype reactors will be constructed as part of AEC's program when plans for experimental work indicate that technical or economic information and operating experience to be derived from the facility are essential to the Commission, or to the power industry, to reduce nuclear-power costs.

In its plans the AEC includes testing programs, continuing evaluation and reappraisals, and program reviews.

Within the next ten years then, greater strides than ever can be expected in U. S. nuclear power development—strides that will place the atom in an envious position as a future competitive power source.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

AN ENGINEER LOOKS

Tomorrow science will
have moved forward
yet one more step,
and there will be no appeal
from the judgment which
will then be pronounced
on the uneducated.

Alfred North Whitehead, 1916

I WISH to approach the problems of education from an unusual point of view—the point of view of an engineer. I am not an educator, but I have had some experience in teaching at the college level, and I made the first full-length educational movie that the General Electric Company produced in 1928. Sometimes one outside the immediate field of work can see solutions clearer than those who are close to the problem.

From the statistics in a recent World Almanac, the public schools in this country had 25.2 pupils to each teacher in 1900. In 1930, there were 24.9 and in 1950 there were 24.2. Another set of data from the U. S. Department of Commerce indicates that this has gone from 36 pupils per teacher in 1900 to 27 per teacher in 1956. This latter source states that the students per teacher in all forms of higher education have gone from 11.4 in 1940 to 8.8 in 1956. Thus there has been no increase in the effective number of students per educator, in fact a decrease.

Why should we expect any change? The educator today is still using the tools of 150 years ago; i.e., a textbook, a blackboard, pad and pencil, crude laboratory equipment in some cases, and devoted personal instruction, but applied through a presentation of much of the same material over and over, year after year. Further, according to reports by many who should know, this material has had insufficient change to keep pace with the changing knowledge of today.

[1] Vice-President and Consultant, Turbine Division, General Electric Company, Schenectady, N. Y.

Based on an address delivered at the President's Luncheon during the Annual Meeting, Atlantic City, N. J., November 30–December 4, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The Engineer's Viewpoint

It seems to me that the educator must have more modern tools to do the job, more modern organization, methods, and management, and that these should be such as to improve the quality of education, not deteriorate it. They should free the devoted teacher's time and energy for the person-to person contacts so necessary in the educational process.

During World War II, when the immediate training of millions of men in specialized techniques was a matter of survival, we developed many highly effective techniques. But few of these, I am told, have been carried over into our civilian institutions. To be sure, these were training methods as distinguished from educational methods, but they were communication, which is the basis for both training and education.

It would seem, first, that we need study, evaluation, and sympathetic application of new organization and management techniques. For example, in Bay City, Mich., it has been reported that nearly a 30 per cent reduction in teacher costs has been brought about in some of the elementary schools by having twice as large classes handled by an education-trained teacher and a nonprofessional "teacher's aide." The teacher's aide does the multitudinous nonteaching chores now required of the fully trained professional teacher. Tests made of the results in such classes have indicated superior learning as compared to the old organization.

Similarly, advanced postgraduate education has been carried on for years on a large scale with great success by the General Electric Company, using selected graduates of the preceding one or two years to teach the current classes. The extension of this technique to college-level teaching might also provide an excellent extra training in both technology and communication, as well as provide extra income for the 2 to 5 per cent of students selected.

Subject Matter—or Methodology

There is need to resolve, by careful study, the present unfortunate basic difference of opinion in education circles as to the comparative desirability of a teacher's knowing subject matter or the methodology of teaching. I suspect here it will depend upon the subject and the teacher.

The penetrating analyses of Dr. James Conant, Beardsley Ruml, and Admiral Rickover, as well as others, of the inadequacies of our present educational organizations should be given most careful consideration by all those who have these responsibilities. Proper remedial measures in organization, management, curriculum content, and teacher qualification requirements should be taken.

But most important, I believe, it is absolutely necessary that the educators develop and put into use the extensive audiovisual communication and teaching aids that modern technology has provided. Here there need be no harmful competition between television and sound motion pictures. The essential thing is that full semester-long recorded films or tapes be prepared by outstanding teachers covering most high-school and college subjects, and many elementary subjects. These should be used on alternate days with automatic or student-aide projection, with the teacher personally handling the class on the other days. In this way, the personal touch so necessary to top-level instruction could be maintained, the enthusiasm of the outstanding educator who prepared the film could be transmitted, and adequate lab

By GLENN B. WARREN, past president, from the American Society of Mechanical Engineers

AT EDUCATION

equipment used. Travel and remote area participation in the picture would be provided, and, what is probably also important, representations to students of hard-to-comprehend parts easily arranged. The films could be kept up to date by insertions or substitution.

A teacher's coverage of students in this way could be doubled or tripled, and we could, therefore, afford to pay them more, as we do others whose effectiveness is increased.

Such complete films, so far as I know, are available in only two subjects today, i.e., high-school physics and chemistry. The physics film is being used in more than 500 classrooms; the chemistry film has just been made available. Tests made with many classes taught by the physics film indicate superior learning results, and so far it has been used principally to raise the level of teaching. I believe it can be used to increase the coverage of teachers, and that a high school would, depending on the number of classes taught, save the first cost of the film in two years, and perhaps in one year.

Despite these potential new tools, our educational costs will probably go up and never come down. I have been asked, "How will we pay for these? Aren't taxes too high now?" Certainly taxes are high, and let us hope and pray that our defense burdens can be reduced. But we have no choice so far as education is concerned. We must meet our educational needs. Part of this will be met by our increasing productivity year by year, and 20 years from now our productivity should be nearly twice what it is now, but it will then have to be shared by more people.

It has been shown that a high-school education returns 10 to 20 times its cost in increased lifetime income to the one taking it—plus an increased return to society. Similar high returns can be shown for a college education. Surely this is a good investment for the public through its local and national government.

Relative Costs

Perhaps we may have to choose between education and certain other things. We spend about $16 billion per year today on educating the oncoming generation. This is only 4 per cent of our national income. We spend almost as much on tobacco and liquor, and twice as much on our motorcars—not counting the roads. We spend almost this amount on our television, radio, and motion-picture amusements. I have no quarrel with any of these. I think we can have them and enough for education too. If not, it is a matter of choice as to what is most worth while.

Education is largely a local responsibility in this country. Each individual, each industry in each locality, can get into the act and increase the effectiveness of his school system. Many local engineering society sections are organizing to contribute important help in this regard. I have been astonished at the wealth of information, pamphlets, books, and guidance on all phases of this matter that are available. A letter to ASME Headquarters inquiring for references will bring a response and will permit you to obtain such information for the guidance of your local group.

I have tried to paint a picture of our needs for more and better education, for higher pay and better standing for our educators and teachers, and without losing sight of the real revolt of the taxpayers against the increasing cost of such education. There are available modern engineering and management solutions to many of these problems, and more can be and should be developed. I hope that we as engineers and citizens can use our influence to bring these solutions to bear.

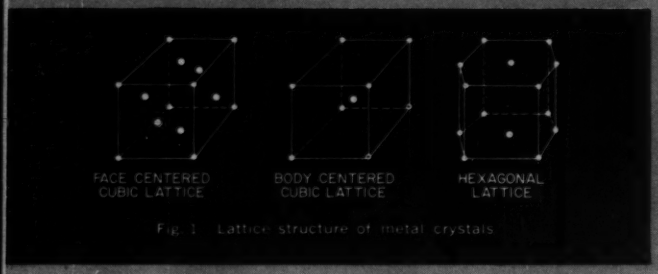

Fig. 1 Lattice structure of metal crystals

MATERIALS BELOW -100 F

By O. A. Hansen, Engineering Consultant, Linde Company, Division of Union Carbide Corporation, Tonawanda, N.Y.

For low-temperature operation: The right material plus the right method of fabrication.

THE selection of materials suitable for low-temperature operation depends not only upon the proper material, but the treatment of that material before fabrication, the methods of fabrication, and the test procedures that have been used. These leave a marked effect on the finished article which is reflected in its properties for low-temperature operation.

The metallurgist groups metals according to the arrangement of the atoms in the crystal, Fig. 1. Those metals with similar lattice structures generally show the same reaction at low temperature. Metals which have a cubic lattice with an atom in the face of each surface show no loss of ductility at low temperature, but those which are "body-centered" or have a hexagonal lattice show a marked tendency to brittleness at temperatures below a "transition range."[1] The hexagonal-lattice materials are similar to the body-centered metals except that the transition temperature is well above room temperature, and hence the material behaves as if it had no transition-temperature range when used for low-temperature work. The ductility for several metals, as indicated by the notched-bar impact value, is shown in Table 1.

It will be noted that the ductility of the face-centered metals improves at low temperatures, while that for iron falls to a very low value. Fortunately, iron can be alloyed in such a way that the reduction of ductility is not so severe.

[1] Curves of ductility versus temperature for body-centered metals are generally S-shaped, with a nearly vertical drop of ductility at some narrow temperature range—called the transition temperature or transition range.

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Face-Centered-Lattice Materials

Copper. Copper was the most widely used material for early low-temperature work because its formability and the ease of making joints with soft solder made it a natural metal for construction of experimental equipment. When that experience was carried into the commercial field, the drawbacks of low strength and the unreliability of soft-soldered joints were emphasized.

The ultimate strength and yield point of copper were increased considerably by alloying, as for example, to obtain the $3^1/_2$ per cent silicon alloy. The values at room temperature for the annealed state are an ultimate strength of 62,000 psi compared with 33,000 psi for pure copper, and a yield point (0.5 per cent offset) of 21,000 compared with 8000 for pure copper. Reduced temperatures tend to improve the properties of the alloys to about the same extent as for the base metal.

Aluminum. Since production facilities have increased and prices have been lowered, aluminum has been much more widely used for low-temperature service. In its pure state, it has easy-working characteristics, but it is not very strong. Alloys with improved physical properties which retain most of the easy-working features of the pure metal are being developed. Table 2 shows the room-temperature physical properties of one of the new alloys for which the ASME Boiler and Pressure Vessel

Table 1 Notched-Bar Impact Values

Metal	Crystal lattice	Energy to break, ft-lb: At room temp	At −320 F
Aluminum.....	Face-centered cubic	19	27
Copper.....	Face-centered cubic	43	50
Nickel.....	Face-centered cubic	89	99
Iron (Armco)....	Body-centered cubic	78	1.5
Titanium.....	Hexagonal	14.5	6.6
Magnesium....	Hexagonal	4	(3 at −105 F)

Fig. 2 Transformation of austenitic stainless steel to the martensitic form takes place after prolonged exposure to very low temperatures. The end of a valve stem used in liquid-oxygen service for several years which had been at room temperature all the time was unaffected, but there was sufficient martensite at the cold end to hold a magnet.

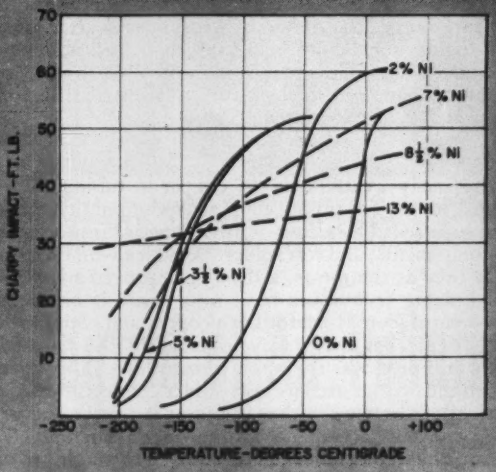

Fig. 3 Impact strength of nickel steel

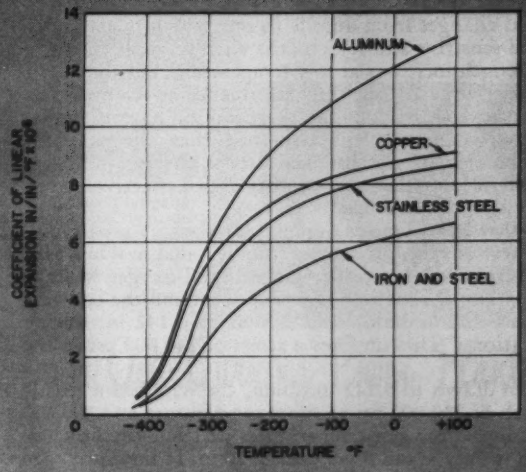

Fig. 4 Linear coefficients of expansion

Code has established the design stress. The physical properties are not changed much by a reduction of temperature, except generally to "improve" them.

However, alloying both copper and aluminum reduced the thermal conductivity—by a factor of $8\frac{1}{2}$ to 1 for copper-silicon alloy, and nearly 2 to 1 for the aluminum 5083 alloy compared to pure materials.

All the aluminum alloys as well as pure aluminum are ductile at low temperatures; and, in addition, they are noncorrosive and easy to fabricate. For most pressure-vessel work, alloys must be weldable; and, until recently, the strongest weldable aluminum alloy had an ultimate strength of only 25,000 psi. Since these alloys were one third as heavy as stainless steel and only one third as strong, and cost approximately the same on a weight basis, there was not much incentive for their use. The heavier gages required with aluminum increased welding costs and proper welding procedures did not exist.

There are now standard procedures including welder training, and rigid control on cleaning procedures and weld design which insure sound joints. Also, the development of new weldable alloys such as 5154, with ultimate tensile strength of 30,000 psi and newer alloys in the 40,000 and 42,000 range, further brighten the future of this metal. However, the fatigue limit of all aluminum alloys when welded is only 5000 to 10,000 psi after a few million cycles.

Table 2 Properties of Aluminum Alloy and Aluminum

Property	5083 alloy	Aluminum 3S	Aluminum 2S
Ultimate strength	45,400	15,600	9,500
Yield point, psi—0.2% offset	21,800	6,000	2,500
Elongation, % in 4D	23	43	25
Reduction of area, %	35	81	...
Thermal conductivity, Btu per hr per ft per deg F	60	92	103

Austenitic Stainless Steels. The austenitic stainless steels, if kept in the austenitic state by proper heat-treatment and composition (for example, low carbon content) are excellent at low temperatures. The low-temperature toughness of the base metal may drop if the metal is cold-worked, or if the carbides have separated because of improper heat-treatment. Even under somewhat adverse conditions, the toughness is comparatively high, with Charpy-impact values of 30 to 50 ft-lb.

In order to insure welds of satisfactory ductility and toughness (normally much lower than for base metal) alloys having high carbon content such as the AISI 302 steel are not used. The 347 stainless steel is not quite as bad, but weld-toughness is borderline. Welds in 304 stainless steel are heat sensitive and are deleteriously affected unless the proper filler metal is used. For example, if postweld heating is encountered, as from a brazing process, the Charpy-keyhole toughness of a standard 308 electrode weld may drop to as low as 5 to 10 ft-lb. This effect is even noticed in multiple-pass welds where earlier welds are affected by the latter.

Hence stainless steel should not be stress relieved in the carbide-precipitation range (850–1600 F). Little value is obtained below 850 F, and distortion and improper cooling may be found at the higher temperatures.

It is interesting to note the transformation of the austenitic stainless steel to the martensitic form after prolonged exposure to very low temperatures. One end of the stem of a valve used in liquid-oxygen service for several years had been at room temperature all the time, and showed no magnetic properties, while in the cold end there was sufficient martensite to hold a magnet, Fig 2.

The author knows of no failure which can be attributed to this conversion to martensite. Even where it is appreciable, there is no great loss of ductility.

Body-Centered-Lattice Materials

Iron and Steel. Iron and steel are the most common materials of the body-centered-lattice group, and are the most generally used construction materials. However, the material must be specially alloyed for use at low temperatures, and for most applications the alloying must be extensive.

These materials have a transition range wherein the material changes from ductile to one which is markedly notched sensitive and which fails with a brittle fracture. The strength increases at low temperature, but the notch sensitivity is such that the performance at temperatures below the transition range is generally unpredictable. If there were complete assurance that the material could be free of notches and stress raisers, the high strength of low-alloy steel might be used effectively even at very low temperatures.

Low-Alloy Steel. One example of satisfactory use of low-alloy steel at very low temperature is found in wires used in prestressed concrete for large liquid-oxygen storage tanks. The wire which is wrapped around the concrete tank is 0.162-in-diam, cold drawn to 0.142 in. during application. This imposes a stress of 140,000 psi in the wire.

When drawn to 0.142 in. diam, the wire has a tensile strength of 230,000 psi at room temperature and 300,000 psi at liquid-oxygen temperature. Although the elongation is only about 2 per cent in 10 in. at liquid-oxygen temperature, several test specimens have been bent at over 90 deg before fracture.

Nickel-Steel Alloys. The general effect of the alloying of various amounts of nickel with steel is shown in Fig. 3. It will be noted that the transition range moves to lower and lower temperatures with increasing nickel content, and that the residual ductility is somewhat higher. When the nickel content is raised to 8.5 per cent, however, the transition temperature drops below −320 F, and the alloy has characteristics quite unlike the lower alloys. It becomes a material quite well suited for low-temperature work, but there may be some unusual problems encountered in its use.

Nine per cent nickel steel is specified as SA-353 and has an allowable working stress of 22,500 psi except where the weld-metal stress is limiting. Welds made with Inco Rod A have tensile strengths of 109,000 psi and yield strengths of 70,000 psi. The finished vessels must be reheat treated by stress relieving at between 1025 and 1085 F for 2 hr or more, depending on the thickness.

Cast Iron. Cast iron is an interesting material at low temperatures. It has very little ductility at room temperature, and loses about half of that at low temperature, although alloying with nickel permits retention of more ductility. With its many graphite inclusions, it is so full of notches that the effect of extraneous notches goes unnoticed. Many cast irons show a tendency to increase in volume after being subjected to very low temperature.

The code does not specify minimum impact strength if the safety factor is more than 20 to 1, although in using cast iron it may be about 40 to 1. There are data to show that a crack cannot be initiated or propagated even in brittle material if the stresses are below 6000 to 10,000 psi.

Piping Flexibility

Changes in material characteristics can introduce many new variables in the computations for stresses which occur because of reduced temperature. The modulus of elasticity increases somewhat at low temperatures, but the effect is not serious because the thermal expansion is reduced at very low temperatures. Fig. 4 shows the reduction of the thermal expansion for a number of materials.

There is another factor, however, which must be taken into consideration. That is that low-temperature equipment is usually constructed at the midpoint of the temperature range, the material being heated after fabrication for drying, before being subjected to low-temperature operation. This makes it impossible to use "cold-springing" at room temperature to limit the maximum stress at the operating temperature.

Solders

The ready availability of copper in tubing form extended its use for piping long after the pure copper had been superseded by alloys or other metals for pressure-vessel components, and soft solder (50-50 lead-tin) continued to be used at the joints, although improved silver solder and brazing techniques have now made it obsolete for low-temperature work for both copper and copper alloys.

A simple but major development in the hard-solder joint in piping was the establishment of a short overlap. When the fittings used for soft-solder connections are used with silver brazing, either the joint is overheated or the joint contains a trap. With an overlap of only $1/4$ to $3/8$ in., the silver solder can be "flowed through" to make a pocketless joint without burning the piping. This does away with the possible wedging open of the joint from the continued freezing and thawing of moisture retained in the joint.

An early source of much trouble was the lead content of many of the cast fittings used for soft-soldered piping. Silver brazing on these fittings would not be successful because the lead would separate and contaminate the brazing alloy and result in cracking.

Aluminum to Stainless-Steel Joints. Smith and Rabb[2] describe four methods of joining aluminum to stainless steel; all are aimed at means of tinning the aluminum so that a subsequent soldering operation can be carried out between two compatible metal surfaces: (*a*) Copper-plated aluminum to stainless steel, (*b*) ultrasonic-tinned aluminum to stainless steel, (*c*) friction-tinned aluminum to stainless steel, (*d*) aluminum to copper to stainless steel. In all cases, the solder is subjected to severe stresses by any change in temperature because of the extreme difference in thermal expansion of the two base metals. If the solder layer is too thin, there is so much resistance to flow that the stresses may be extreme. If the solder layer is thick, it may present problems because of its own inherent weakness. The use of a mechanical joint to relieve the solder from stress with the solder acting as a seal makes a satisfactory arrangement.

Several new methods are being developed to join aluminum to other metals. The refrigeration industry uses flash welding of copper and aluminum tubes. The Al-Fin process casts a layer of aluminum on a "pretinned" part made of some other metal. The commercial product, copper-clad aluminum, can be used as an intermediate part, with aluminum welded to the aluminum part and copper or steel to the other part. It is necessary in this case to strip the opposite metal from the area near the joint to prevent weld or braze contamination.

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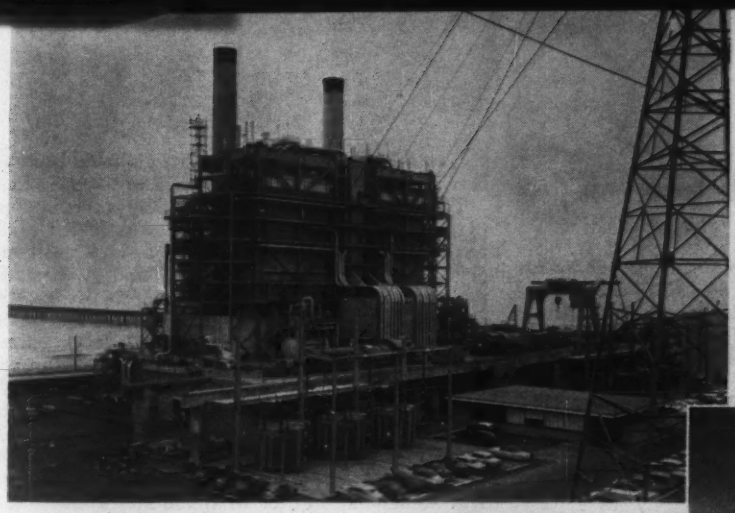
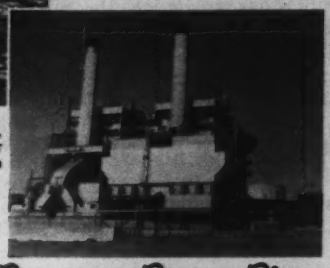
[2] Morton C. Smith and David D. Rabb, in the Proceedings of the 1959 Cryogenic Engineering Conference.



Practicable methods have been developed by the utility industry for reducing the particulate, sulfur-trioxide, and nitrogen-oxide emissions from fuel-oil combustion



Above, El Segundo Steam Station of the Southern California Edison Company, the site of most of the research on the control of air pollution from oil-burning power plants. **Right,** The full-sized prototype electrostatic precipitator for the large oil-fired boiler is at the rear of the station.

Control of Air Pollution from Oil-Burning Power Plants

By H. C. Austin and W. L. Chadwick, Mem. ASME, Southern California Edison Co., Los Angeles, Calif.

SINCE the previous report on control of air pollution from power plants in Southern California was made in 1957,[1] Southern California Edison Company has continued its research and development work in that field with significant progress. Although most of the work concerns the combustion of fuel oil, some of the results may also apply to control of pollutants from combustion of coal and natural gas and be helpful to air-pollution control efforts in general.

In 1951, A. J. Haagen-Smit proved conclusively that the reaction between unburned hydrocarbons and nitrogen oxide in strong sunlight produced the characteristic air-pollution condition in Southern California. With this understanding of the basic chemical reaction, efforts have been made to control the release of hydrocarbons and much has been accomplished by industry toward this end.

To assist in fixing perspective, it may be stated that at the end of 1958, assuming an average of only 100 hp per engine, there were 78 times as many kilowatts operating in automobiles, trucks, and buses in the Los Angeles basin as there were in all the thermal-electric power plants in the same area. These automobile kilowatts represented twice the kilowatt capacity of all thermal-electric plants in the United States. The computed outputs of the five principal pollutants caused by combustion of fuels in Los Angeles county are shown in Table 1.

The major role of the internal-combustion engine in forming pollutants, including both hydrocarbons and nitrogen oxides, is obvious.

[1] A. J. Haagen-Smit, "Studies of Air-Pollution Control by Southern California Edison Company," *Trans. ASME—Journal of Engineering for Power*, vol. 81, series A, January, 1959, pp. 1–6.

Contributed by the Air Pollution Controls Committee and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 59—A-71.

Plume-Opacity Regulation

In 1947, a State law was passed which was intended to regulate air pollution from industry by declaring it a violation whenever any stack plume becomes "of such opacity as to obscure an observer's view to a degree equal to or greater than" smoke of Ringelmann No. 2 shade for more than 3 min in any hr. In 1955, new power-generating stations in Los Angeles County aggregating 1 million kw in capacity were denied permits to operate because it was charged that when burning fuel oil they would on occasions violate the opacity regulation. Control regulations also set 0.2 per cent by volume of sulfur measured as SO_2, as the maximum allowable release from a stack and set not more than 0.3 grain per standard cu ft as the limit for dust loading. In typical experience, the sulfur products have been about one half and the dust loading about 15 per cent of allowable limits. But, at times, dependent upon several variables, the Ringelmann No. 2 opacity requirement could not be met. As a result, because curtailment of the production of electric power and the resulting losses to the public were completely unacceptable, hearings and variances became necessary.

Table 1 Total Emissions of Air Contaminants, Los Angeles County, Tons per Day

		Smog formers					
	Carbon monoxide	Hydrocarbons	Nitrogen oxides	Sulfur oxides	Aerosols	Totals	Per cent
Autos, trucks, and buses	4200	1000	433	49	34	5716	68
Power plants	0	0	136	109	11	256	3
Misc. other sources	1400	450	131	392	55	2428	29
Totals	5600	1450	700	550	100	8400	100

NOTE: From data compiled by the Air Pollution Control District of Los Angeles County.

Control of Air Pollution from Oil-Burning Power Plants

Research Program

One of the first major research and development problems and one which was related to all of the investigations, was the selection of reliable and reproducible analytical methods which would be acceptable to all of the participating agencies. This selection involved proving methods for measuring: (*a*) the particulate content of a gas stream, (*b*) the SO_2 content, (*c*) the SO_3 content, and (*d*) the NO content. One illustration of the initial breadth of disagreement was the difference between 20 ppm and 500 ppm in the results of two commonly used methods for determining the NO content of the same gas stream. The following specified sampling techniques now give reproducible and acceptable results and data:

Particulates	—	blackness test
SO_2	—	hydrogen-peroxide barium-sulfate method
SO_3	—	barium-sulfate method
NO	—	phenoldisulfonic-acid method

A literature search and industry conferences in large number were carried out to determine whether it would be economically feasible to remove from oil at the refinery: (*a*) the sulfur, and (*b*) the incombustible metallic compounds which form ash particles. No economically practicable removal process has been developed which would not increase the cost of electric power prohibitively, but the search has not been abandoned.

Extensive study has shown that a firm and adequate supply of fuel oils of low sulfur and ash content is not readily available. While some crudes may have sulfur contents as low as 0.1 per cent, they are not common—in fact, they are unusual among the asphaltic-base crudes which form the principal petroleum supply of the West. Many of the heavy crudes which yield the highest amounts of fuel oil have sulfur contents of from 2 to 5 per cent. Furthermore, most fuel oils are blends of crudes from several fields which differ chemically to some extent, and isolation of fuel oil from particular crudes is not practicable. There is some foreign low-sulfur oil available at times, but so far not in significant quantities.

Reduction of Plume Opacity

Much effort was directed toward the reduction of plume opacity—the only air-pollution-control rule which the utilities were charged with violating. In spite of continuing studies, the physics of this phenomenon are still not fully understood. It is generally agreed that plume opacity is affected significantly by: (*a*) the amount and size of particulate matter present in the stack gas, (*b*) the amount of SO_3 present, and (*c*) the amount of water vapor present. Opacity also depends greatly on: (*a*) atmospheric conditions, (*b*) lighting conditions, and (*c*) the background against which the plume is observed. In an elaborate study of the conditions under which plumes form, made at a coastal station, colored photographs were taken every hour from daylight to dark for a period of two months. Wind direction and velocity, air temperature and humidity, light intensity, the amount and type of fuel being burned, the temperature of stack gases, and other pertinent data were also recorded. No clear correlations could be established between the plume appearance and any of these factors.

To determine whether or not SO_3 played a significant part in plume formation, a unit was fueled exclusively with natural gas thus producing a stack gas containing negligible amounts of sulfur and particle-forming material. Under the atmospheric conditions then obtaining, no visible plume was formed. Measured amounts of SO_3 were added to the stack effluent and observations were made of plume appearance and opacity. As little as 3 ppm of SO_3 in the effluent caused a visible plume, and with 15 ppm of SO_3 a conspicuous plume was emitted. With equal concentrations of SO_3 in the discharges of a natural-gas-fired unit and a residual-oil-fired unit, the plume from the natural-gas-fired unit was somewhat lighter in shade and about one half as opaque. That this difference was due to the presence of particulates in the discharge from the oil-fired unit was verified by energizing the electrostatic precipitator on the oil-fired unit. The appearance of the two plumes then became practically identical. When the concentration of SO_3 in the discharge from the gas-fired unit was twice that in the effluent from an oil-fired unit unaided by the precipitator, the plumes appeared to have about the same opacity, but the test-unit plume was somewhat lighter in shade.

The first effort to reduce plume opacity was the removal of particulates, but proved devices were unavailable for the low concentrations involved and it was necessary to carry much of the cost of the manufacturer's research and development work as well as the cost and labor involved in pilot-plant testing. The amount of the fuel-oil ash varies from about 0.05 to 0.15 per cent by weight. This normally produces stack-gas particles of about 0.4 micron size and loadings of about 0.04 grain per std cu ft. The ash particles are microscopic and the quantities are small when compared with those produced by even the better coals.

Two pilot-scale electrostatic precipitators utilizing two differing precipitation principles, and designed by separate manufacturers—Apra Corporation and Western Precipitation Corporation—were built and tested on a bypass from the actual gas streams of the 175,000-kw operating units at Edison's El Segundo Steam Station. Design criteria for full-scale electrostatic precipitators for use on fuel-oil effluents were established in a $500,000 program which required more than a year.

These criteria indicated that about 90 per cent of the 120-lb-per-hr dust loading could probably be removed satisfactorily. Proposals for a full-scale prototype precipitator were invited from each of the two cooperating manufacturers, and the selected unit is under test in full-scale operation at El Segundo. It has a guaranteed collection efficiency of 90 per cent and is similar to those which have been used elsewhere in conjunction with mechanical collectors to obtain a collection efficiency of 97 to 98 per cent on coal-fired boilers. The prototype has a gas velocity of about 7.3 fps, and a treating time of about 2.5 sec. The adaptation to an existing generating unit was somewhat unusual and more expensive than original construction. More elaborate insulator compartments than those used in coal fire precipitators were required because oil-fire gases seem to cause heavier insulator fouling. The collecting system and hopper arrangement are different because of the lower dust loading and nature of the dust. The collected material is highly hygroscopic.

The total cost of manufacturing, erecting, testing, and making modifications of the precipitator which may be necessary will be about $1,000,000.

Pilot-scale filter bags of siliconized glass cloth of several different weaves and of other materials were tested on part of the stack gas from an operating unit. As much as 99 per cent of the particulates from oil fires were collected during some of the tests. The practicability of using such devices, however, depends upon completion of an engineering and economic study of a full-scale collector.

The comparatively high pressure drop through the bags, combined with first costs for the unit itself, indicated that such a device would be more costly than an electrostatic precipitator. In addition, the large physical size of the bag filter would impose some very difficult space problems. The results of later tests with less tightly woven cloth may change this conclusion.

Sulfur and NO Removal

Before refinement of the analytical techniques, the possibility that some of the sulfur products in the stack gases were being removed with the dust in the precipitator was indicated, but this proved to be a false hope. The technical literature indicated that additives to the gas stream might be effective in removing sulfur products and experiments were made.

The first work on additives consisted of injecting solid, finely ground (325-mesh) limestone, calcium oxide, calcium carbonate, and dolomite into the gas streams at two points ahead of the pilot precipitators where the gas temperatures were about 700 and 300 F. No appreciable lowering of the SO_3 concentration was obtained with any of the materials injected at these points. An extended investigation of the effect of injecting crushed dolomite directly into the furnace had two objectives: (*a*) Determining the effect of additives on the nature of the boiler-tube deposits, and (*b*) determining the effect on formation of SO_3. The SO_3 is reduced from an average concentration of about 13.1 ppm to about 6.1 ppm when crushed dolomite is added at a rate that theoretically reacts with about 10 ppm of SO_3.

Adding gaseous ammonia stoichiometrically, either at the 700 F or 300 F points in the gas stream, caused nearly complete reaction with the SO_3 and almost complete removal. When ammonia gas was added in quantities substantially greater than stoichiometrically, the trioxide was removed but a highly objectionable detached dense white plume was formed at the discharge from the pilot precipitator. This plume apparently results from a reaction between the ammonia and the SO_2, the products of which remain in a gaseous phase at the temperatures in the precipitator, but which form opaque aerosols when the temperature is lowered on diffusion. It was demonstrated that these products can only be precipitated at temperatures at or near the dew point. This reaction does not seem a practical method of removing SO_2 from the stack gases of existing or projected power stations.

A. J. Haagen-Smit of the California Institute of Technology was retained as a consultant and carried on extensive research for more than two years on practical means for reducing the concentrations of sulfur and nitrogen compounds in the stack gases. Three different catalysts were tried comparatively in an intensive bench-scale study of adsorption and catalytic-conversion methods: (*a*) Harshaw vanadium catalyst, (*b*) treated dust from one of the pilot-plant precipitators (this dust contained comparatively high concentrations of vanadium and nickel), and (*c*) Monsanto vanadium catalyst. The latter was found to have an efficiency of about 90 per cent in oxidizing the SO_2 in flue gas at 900 F. No significant reduction in the NO in the flue gas was effected by these catalysts unless ozone was added after the gas had passed the catalyst bed. After such an addition, however, up to 90 per cent of the NO could be removed by a bench-scale electrostatic precipitator. This work was supplemented by tests on a larger catalyst bed. Here at a flow rate of 3.5 to 4 cfm of flue gas, a bed containing 110 grams of Monsanto vanadium catalyst at 900 F almost completely converted the SO_2. The resulting SO_3 could then be precipitated at 300 F.

From this work Haagen-Smit concluded that it is technically possible to remove approximately 75 per cent of the NO and about 90 per cent of the SO_2 from fuel-oil flue gases if these are passed through a vanadium catalyst at high temperature, followed by the introduction of ozone and electrostatic precipitation. Independent cost estimates, however, showed that this is economically infeasible in full-scale operation.

There were 150 adsorption experiments on a bench scale using 15 different grades of charcoal supplied by three different manufacturers. In addition, two lignite charcoals were used through co-operation of the United States Bureau of Mines. After 51 consecutive adsorption-desorption cycles, one of the most promising charcoals still adsorbed 8 per cent of its weight in SO_2 at 150 F. A 20 per cent loss in weight was noted in the charcoal during the term of the test. The efficiency of NO adsorption was significantly less than that for SO_2. The NO was adsorbed first, and was subsequently displaced as the SO_2 break-through point was reached and it became detectable in the effluent. Estimates showed that the cost of a full-scale plant would be prohibitive, ranging from a low of $57 to a high of $285 per kw of station capacity.

Limiting NO Formation

Ways and means of avoiding, or significantly reducing the formation of NO without chemical processing were sought on nine different operating boiler furnaces with: (*a*) differing designs, (*b*) differing firing arrangements, and (*c*) differing configurations. Any or all of these factors might affect flame temperatures and hence NO formation. Flame patterns and NO formation were observed with both natural-gas and fuel-oil firing. Most of the furnaces showed NO concentrations between 500 and 700 ppm when burning oil and from 400 to 600 ppm when burning natural gas. One type of furnace had a comparatively protracted flame path and NO concentration about one half that of the other furnace types. This has resulted in the development of methods of substantially lowering the emission of NO from generating station stacks.

Limiting the formation of NO in furnaces was studied by investigating the NO concentrations in many furnaces of different types, varying combustion factors in a pilot-scale test furnace which contained only one full-scale burner, and then modifying a full-scale operating boiler to embody promising changes.

Tests on 13 different boiler designs elsewhere in the United States provided information, not only for 22 different furnace patterns, but for three different fuels—coal, natural gas, and fuel oil. The coal-fired units had

NO concentrations of 650 to 1460 ppm. Natural-gas-fired boiler effluents contained 190 to 1350 ppm. Boilers fueled with residual oils ranged from 310 to 915 ppm. In all cases where boilers were tested with more than one fuel, the relative concentrations were about the same for both fuels. That is, if a boiler showed high NO levels with coal as a fuel, it also had comparatively high NO values with natural gas or fuel oil. The same relationship followed for furnaces having low NO levels. Tests indicated that the flame temperature and the nitrogen-oxide concentrations were affected by: (*a*) the rate of firing in the furnace; (*b*) the mutual radiation between burners; and (*c*) the manner in which the combustion air was introduced—that is, by its turbulence, its pressure, and its proximity to the fuel-injection points. It was found that by removing approach-cone blades to reduce turbulence and by reducing the pressure drop across the burner throats, an appreciable decrease in NO formation could be obtained with satisfactory combustion conditions. Unsuccessful attempts were made to reduce the nitrogen-oxide concentrations further by: (*a*) gas recirculation, (*b*) varying combustion-air temperatures, (*c*) burner-orifice modifications, and (*d*) changes in excess air within practical operating ranges. The effect of the nitrogen or sulfur contained in the fuels was found to be negligible, leaving fixation of nitrogen in combustion air as the primary cause.

During investigations of the effect of different burner patterns on full-scale furnaces and also from observations on a pilot-scale unit built by Babcock & Wilcox Company, it was found that a substantial reduction NO formation could be obtained if less than normal combustion air was admitted through the burner and the remainder was admitted through an auxiliary air port to mix with unburned fuel beyond the main combustion zone. This method of slightly delaying the complete combustion and protracting the flame path was labeled "two-stage combustion." Tests demonstrated that the decrease in NO depended importantly on the locations where the auxiliary combustion air was admitted, a significant reduction being obtained only if the auxiliary air was admitted above the flame zone. The reduction in NO formation from dampered auxiliary-air ports constructed in the upper rear wall of the full-scale furnace was not as great as had been expected from tests on the pilot-scale unit, and new auxiliary-air ports were cut into the front wall of the furnace above the top row of burners. With 90 to 95 per cent of theoretical combustion air introduced normally through the burners and 15 to 20 per cent of the air through these auxiliary front-wall ports, the two-stage process afforded (*a*) satisfactory furnace combustion; (*b*) a substantial reduction in NO formation; and (*c*) no appreciable change in boiler efficiency. The effect on the boiler of extended continuous operation with two-stage combustion is being determined on one unit at El Segundo Steam Station.

Before modification, the full-scale boilers produced about 685 ppm of NO at full load on residual-oil fuel. The modified boiler under the same load and fuel conditions now produces less than 350 ppm of NO. If no adverse long-term effects develop, other existing boilers may be modified for two-stage combustion. Boilers for new stations of the Southern California Edison Company are being designed for two-stage combustion and wider burner separation. Preliminary tests indicate that full-load operation on fuel oil may be possible with less than 300 ppm of NO. A detailed description of this significant development is contained in a recent report.[2]

One interesting and valuable corollary of the research on removal or reduction of sulfur and NO is the development by Beckman Instruments Company of an infrared gas analyzer which permits the continuous recording of the sulfur and NO levels in stack gases. This instrument replaced hundreds of less reliable and much more tedious manual tests. It was observed in the NO-control research that, under certain flame conditions, some CO can be formed in a furnace, even though combustion temperatures are normally high, combustion is efficient, and an excess of combustion air is maintained. The amounts of CO so formed are below 100 ppm and undetectable with the instruments normally used in power stations. Careful analysis showed that operating conditions under which this monoxide was formed were not entirely normal, but within usually acceptable operating ranges.

Most of the present paper has been concerned with the minimization of air contaminants from the burning of fuel oil. Three of the four principal contaminants produced by burning fuel oil can be avoided and the plume-opacity regulations can be observed if natural gas can be obtained in sufficient quantities for all fuel uses. This ideal situation, however, has never proved practicable because of the interruptibility of the natural-gas supply in favor of domestic and other preferred uses. Intensive efforts have been made, with some progress, to increase the supply of natural gas available for power generation as an aid to minimizing air pollution.

Conclusion

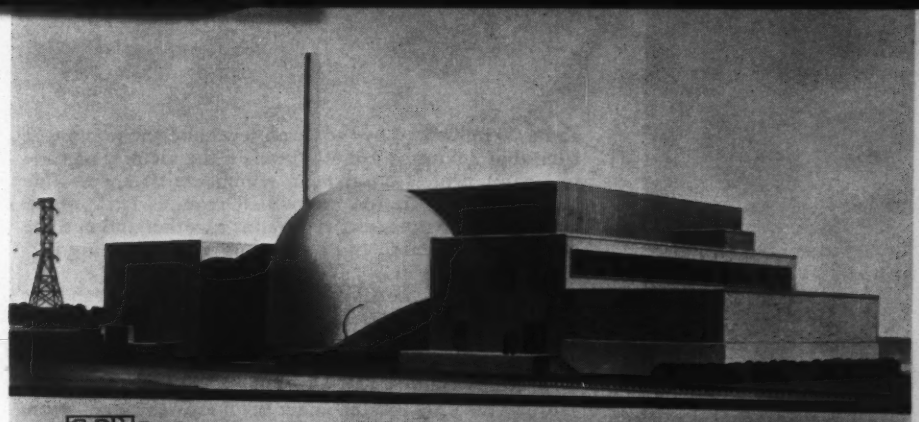
In conclusion, it is desirable to emphasize that, although intensive effort has been applied to (*a*) minimizing the particulate matter emitted from furnaces while burning fuel oil, and (*b*) reducing the emission of sulfur oxides, particularly SO_3, there is no substantial evidence that either of these contaminants has been harmful or has been present in the general atmosphere in sufficient quantities to be considered a significant air pollutant. There is still controversy among authorities as to the health effects of the existing SO_2 levels.

In summary, practicable methods have been developed by the utility industry for reducing the particulate, SO_3, and NO emissions from fuel-oil combustion. Industry in the Southern California area is exerting itself fully and productively toward minimizing the effects of all air pollution which it may cause, while waiting for the automobile, the greatest producer of both of the smog-forming materials, that is, hydrocarbons and NO, to be put under control.

Acknowledgment

The authors wish to acknowledge the aid and contributions to the research work reported here of Truesdail Laboratories, Bechtel Corporation, Apra Corporation, Western Precipitation Corporation, Babcock & Wilcox Company, California Research Corporation, and the members of the Joint Research Council on Power Plant Air Pollution Control of Southern California.

[2] Donald H. Barnhart and Erle K. Diehl, "Control of Nitrogen Oxides in Boiler Flue Gases by Two-Stage Combustion," Babcock & Wilcox Company, presented at the Meeting of the Air Pollution Control Association, Los Angeles, Calif., June 14, 1959.



The Pathfinder Nuclear Plant

This power station, near Sioux Falls, S. D., will use controlled recirculation and nuclear superheat with a boiling-water-type reactor

By Clifton B. Graham, Chief Engineer, Nuclear Power Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

THE 66-emw Pathfinder Plant will be of the heterogeneous type with light water serving as coolant and moderator. The coolant will be circulated by centrifugal pumps, located externally to the reactor vessel, to increase stability and power output over that which could be expected from the same core with natural coolant circulation. The concept is called the Controlled Recirculation Boiling Reactor, CRBR.

The CRBR will be designed for a heat power-level capability of 164,000 kw in the boiling region with a circulation rate of 60,000 gpm. The steam-generation rate will be approximately 600,000 lb per hr at an operating pressure of 600 psig and a temperature of 489 F in the boiling region.

The nuclear superheater will raise the steam temperature to 825 F with a pressure drop of 60 psi or less. The total plant heat output will be 203,000 kw with the turbine-generator producing 66,000 ekw gross. Net power is 62,000 kw, resulting in an over-all net plant efficiency of 30.5 per cent.

The reactor power level will be controlled by a combination of variable coolant flow and movable control rods, Fig. 1. The functions of the control rods are: (*a*) To adjust the reactor power output to the level required by the system demands; (*b*) to compensate for fuel burnup; and (*c*) to adjust flux distribution within the core to optimize burnup patterns.

Varying the volume of coolant-water recirculation independently of the control rods permits gradual and automatic regulation of the power. Thus, if pressure in the steam main is automatically held constant by varying the recirculating volume, the usual boiling-water-reactor bypass-type control may be eliminated. That is, con-

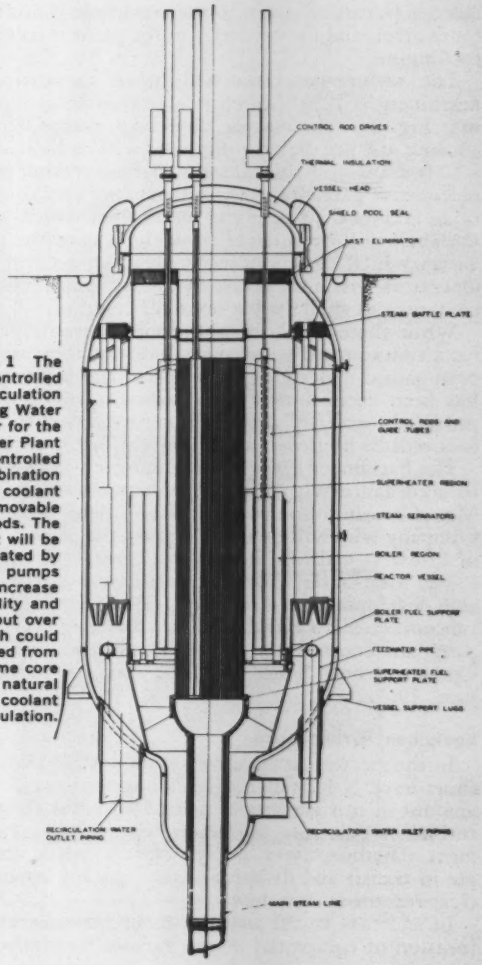


Fig. 1 The Controlled Recirculation Boiling Water Reactor for the Pathfinder Plant will be controlled by a combination of variable coolant flow and movable control rods. The coolant will be circulated by centrifugal pumps to increase stability and power output over that which could be expected from the same core with natural coolant circulation.

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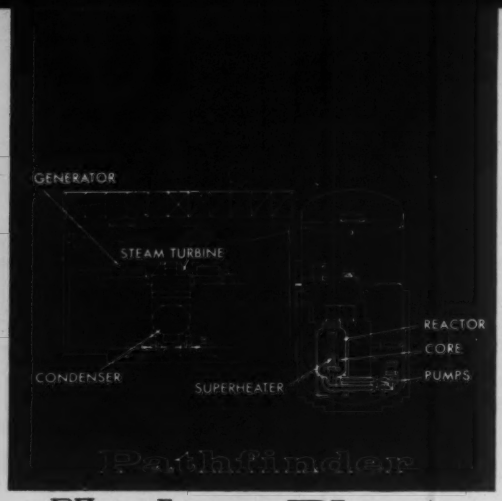

Fig. 2 Reactor, shielding, pumps, emergency coolers, and associated equipment will be located within a 50-ft-diam steel containment shell. Although the steam turbine-generator and other conventional equipment will be unshielded, since the radiation level will be low, operators will be barred from close proximity for more than 20 hr per week.

tinuous bypass of steam to the condenser is not required for control, and the efficiency of the plant is increased accordingly.

The turbine-generator and other conventional-type machinery will be located in a conventional-type building, Fig. 2. The reactor, shielding, pumps, emergency coolers, and associated equipment will be located within a 50-ft-diam steel containment shell to prevent release of radioactive particles to the surrounding area in the event of an accident. Steam and water lines which penetrate the shell will be isolated from the rest of the plant by valves which close automatically if an accident occurs. Operators will have access to the equipment within the containment shell during normal operation.

While there is considerable doubt concerning the need for a containment vessel, until additional experience has been gained in designing and operating nuclear plants, it has been decided that a containment vessel should be provided for this plant. It is expected that future reactors will be housed in more conventional buildings.

The Pathfinder Plant is being designed and constructed in accordance with a contract between Allis-Chalmers Manufacturing Company and Northern States Power Company who will own and operate the plant. A group of Midwest utilities, known as Central Utilities Atomic Power Associates, CUAPA, participate in the research and development. Architectural engineering has been subcontracted to Pioneer Service and Engineering Company, and construction to Fegles Construction Company. Operation near Sioux Falls, S. Dak., is scheduled in June, 1962.

Equipment Arrangement

In the reactor, fast neutrons react with O-16 to produce short-lived N-16 which gives off gamma rays. A small amount of this activity is carried with the steam to the turbine, air ejectors, feedwater heaters, and other equipment. Radioactivity decays rapidly while the atoms are in transit and disappears very quickly when the nuclear reactor is shut down.

In addition to the usual economic considerations the location of equipment in the various buildings, Figs. 3 and 4, is influenced by radiation level and the integrated time that an operator must spend in the vicinity of various equipment. Equipment which emits appreciable quantities of radiation but which requires little or no attention from operators is grouped together and in some cases located behind light shielding with servicing performed semiremotely.

Operators will be allowed inside the railing around the turbine and feedwater heaters for a limited time only—approximately 20 hr per week—but time is unlimited outside. Normal operation will require much less than 20 hr in the vicinity of the turbine. The main sources of radioactivity are located under the floor—the main steam line, the air ejector, and the feedwater heaters. This equipment is inaccessible during operation.

Full advantage is taken of natural shields such as the heavy casing of the turbine, the thick layer of water in condenser heads, and the heavy turbine foundations. Radiation will be very low at the feedwater pumps because considerable time is required for water to get to this point from the reactor, and because most of the gases have been removed by the air ejectors which are located upstream from the pumps.

Operators may work continuously above the fuel-storage pool or on the operating floor of the reactor building. Access to lower floors in the reactor building will be slightly restricted and is prohibited in the recirculation-pump rooms during normal operation.

Recirculation-Pump Advantages. A major contribution to over-all efficiency is found in the three large-capacity circulating pumps which will be installed on the reactor. Their use will permit very high heat output from the core while maintaining good flux distribution. Without the pumps, power density in the top of the core would be reduced to a fraction of the average because of the very large void content. Because the water-circulating rate is not dependent on density differences, as in the natural circulating systems, the pumps will permit high feedwater temperatures. This results in efficiencies that approach those of modern conventional power plants.

The pumps will be of mechanically sealed vertical-shaft design with overhung impeller, positioned by a fluid-piston-type hydraulic bearing. Conventional electric-motor drive will be utilized. It is interesting to note that the recirculating pumps require less than 1 per cent of the gross electrical output.

Pump-Maintenance Features. The pump installation will permit maintenance and repair during operation. Valves are provided in the suction and discharge pipes, making it possible to service one pump while the other two and the reactor are in operation. Radiation shielding is provided between the pumps because of the radioactive water.

When flow is stopped in the pump to be repaired, the N-16 activity decays very rapidly to a negligible quantity, making direct maintenance possible. A small leak through the valves will not raise the radiation level appreciably. If a significant leakage occurs, a fresh-water purge can be introduced upstream to prevent radioactive water from entering the pump.

Steam Separators. The possibility of cavitation in the pumps because of steam-bubble entrainment in the recirculating water was recognized because of the small surface available for steam release and the high water velocity in the coolant downcomer passage outside the core. Therefore, steam-separator devices were developed to remove steam bubbles from the water. A principle

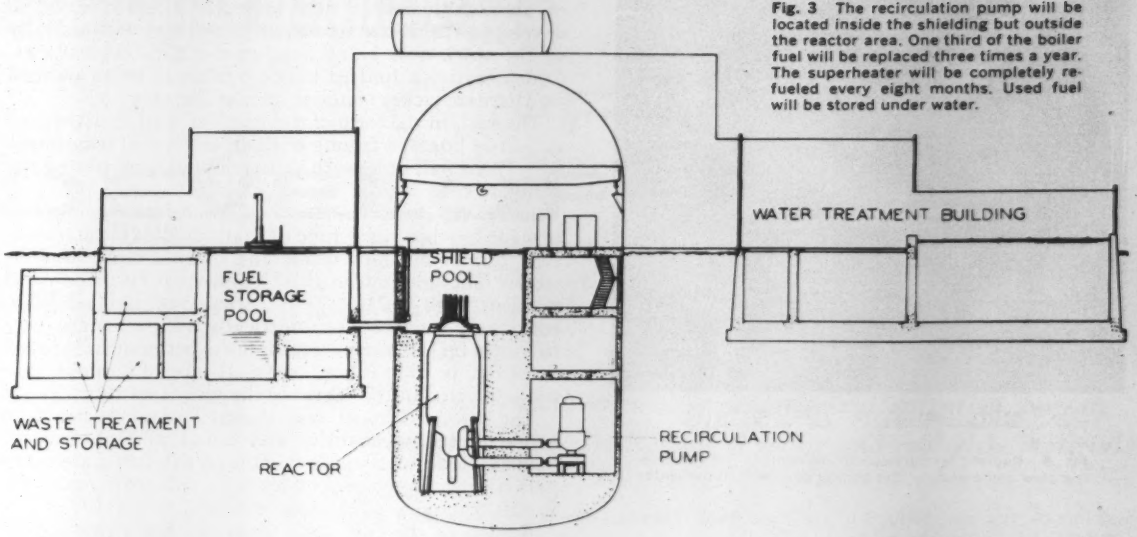

Fig. 3 The recirculation pump will be located inside the shielding but outside the reactor area. One third of the boiler fuel will be replaced three times a year. The superheater will be completely refueled every eight months. Used fuel will be stored under water.

Design Data CRBR With Nuclear Superheater

Plant

Power, boiling region, kw	164,000
Power, superheating region, kw	39,000
Total core power, kw	203,000
Gross electrical capability, kw	66,000
Net electrical output, kw	62,000
Net efficiency, per cent	30.5
Steam outlet pressure, psi	540

Reactor

Vessel size, ft	11 × 26
Total core dimensions, ft	6 × 6
Dimensions of superheating region, ft	6 × 2⅓
Fuel, boiling region (Al clad)	1.7% enriched UO_2
Fuel, superheating region (S.S. clad)	93% enriched UO_2
Fuel, loading, boiling region	117 kg (U-235)
Fuel, loading, superheating region	36 kg (U-235)
Power density (boiling core), kw per liter	49
Reactor operating pressure, psi	600
Temperature, boiling region, deg F	489
Outlet temperature, superheating region, deg F	825
Gross heat rate, Btu per kwhr	10,370
Containment shell size, ft	50 × 120
Av. heat flux, boiling region, Btu per hr per sq ft	130,000
Av. heat flux, superheating region, Btu per hr per sq ft	85,000
Max. heat flux, boiling region, Btu per hr per sq ft	430,000
Recirculation rate, gpm	60,000
Recirculation pump power, kw	620

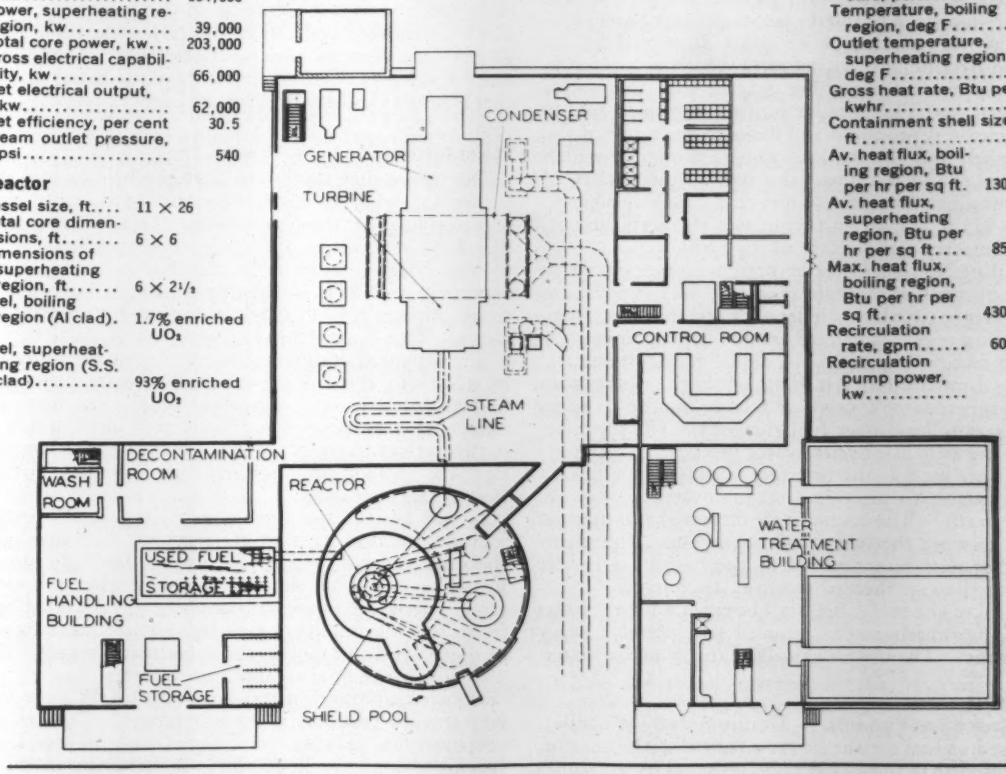

Fig. 4 Plan view of the Pathfinder Plant

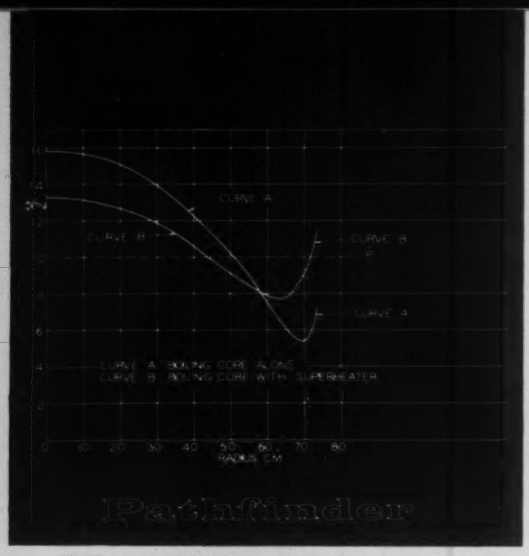

Fig. 5 Radial thermal-neutron distribution for the boiling core alone and for the boiling core with superheater

similar to the cyclone separator is used. Separation is achieved by centrifugal force in the rotating liquid. As a result, the bubbles are driven to a void in the center of the separator. The separators are arranged around the inside of the reactor vessel outside the core region.

Reactor Core. In order to obtain high plant efficiency and to eliminate moisture problems associated with saturated steam, high temperature is needed. This will be accomplished by a nuclear superheater which is located in the center of the reactor. The reactor core consists of two regions: (*a*) The annular boiling region in which saturated steam is produced and flows to the dome of the reactor vessel, and (*b*) the central-core region in which the steam is conducted down through a multiplicity of tubes containing stainless-steel-clad fuel elements. Heated to 825 F, the steam then passes through the bottom of the reactor and directly to the turbine.

The boiling and superheater regions are designed to function together as a single reactor. The superheater section is a right circular cylinder 6 ft high and 30 in. diam.

The boiling region is located around the superheater as an annular section 21 in. in radial depth, resulting in total active core dimensions of 6 ft diam, 6 ft high. In its plan view, the superheater consists of a large number of tubes in which steam flows over fuel elements. The space between the tubes is filled with water moderator. Double tube walls are used at the interface between superheated steam and water to provide a stagnant steam layer between the walls. The stagnant steam serves as a thermal insulator between the water and hot steam. The superheater tubes will be supported at the base by a header into which the superheated steam is discharged.

One third of the boiler fuel will be replaced three times a year. The superheater is refueled (completely) every eight months. The used fuel will be stored under water.

Fuel Elements

Boiling-Region Fuel Elements. Uranium-dioxide pellets will be used as fuel for the boiling region of the reactor. It is proposed that these pellets be jacketed by an aluminum alloy. It is uncertain, as yet, whether corrosion resistance is adequate. Allis-Chalmers has built and is operating several loops for the dynamic corrosion testing of aluminum alloys. It is expected that information developed from this work will contribute substantially to the work now being done in the AEC laboratories. Concurrently, a limited back-up effort is being pursued on alternate jacket material such as Zircaloy.

The fuel, in the form of rod bundles, will be assembled in 5-in-sq boxes, 8 ft long with an active fuel length of 6 ft. There will be 96 such subassemblies constituting the annular boiler region.

Nuclear-Superheater Fuel Elements. Each fuel-bearing tube is made by cladding a tube of uranium-dioxide stainless-steel cermet on both inside and outside with stainless steel. The uranium in these elements is enriched to 93 per cent with U-235. Two fuel-bearing tubes of different size are assembled concentrically with a hanger piece to form a fuel element. Steam flows between and around these fuel-bearing tubes. A small tube of burnable poison is located in the center of the inner fuel tube.

The cermet element was chosen because it has been manufactured in quantity and tested to high burnup. Sufficient information is available on this fuel material to gain a high degree of confidence for successful operation in this reactor.

Results of the cost study indicate that a low-enrichment element—enriched to approximately 2 per cent with U-235—could be used to considerably improve the economics of the fuel cycle because of the plutonium produced. This element would be designed as a hollow uranium-dioxide cylinder clad internally and externally with stainless steel. This low-enrichment element has been taken into consideration in the superheater design already described and can be directly substituted for the 93 per cent element used as a reference. Considerably more development work will be required before the 2 per cent element can be used with confidence.

Power Distribution in the Regions

The power distribution in both the boiling and superheater regions is optimum when the center of the boiling region is used for the superheater. This location also reduced the magnitude of the negative void coefficient due to the boiling region. Using this geometry for the superheater core, it is possible to design the system for more uniform power distribution than for a boiling core alone. This is shown in Fig. 5.

The proposed design minimizes the reactivity that will be added to the reactor when the steam passages are flooded with water. Dispersal of the fuel into small units and a proper water-to-fuel ratio accomplish this. A theoretical analysis indicates that the reactivity addition due to flooding is low enough to remove any question of safe operation.

It was stated that both the boiling and superheater regions function as a single reactor. For this reason, the same control system used for the boiling region adjusts the power of the superheater region proportionately. Relative power adjustments, necessitated by different fuel burnup in the two regions, are made by means of poison rods located in the superheater region. These also adjust the final steam temperature.

Construction and operation of the CRBR are a logical step toward economical nuclear power. The design incorporates a number of cost-reducing features—high specific power, excellent power distribution in the core, high thermal efficiency, and relatively low fuel-fabrication costs.

2-YEAR REVIEW

RUBBER DEVELOPMENTS

review of the literature for the years 1957-1959

From wire mesh in tires, to radiation vulcanization, here are two years in the development of rubber and rubberlike materials

By Leora E. Straka, Research Librarian, Goodyear Tire and Rubber Company, Akron, Ohio

THE search for new and better rubbers to satisfy present and future requirements has been one of the high lights of the rubber industry during the past few years. Specialty rubbers, general-purpose rubbers, and low-cost elastomers have stimulated healthy competition in the industry [1, 2].[1]

New Rubbers

Viton A. The most recently introduced fluoroelastomer, Viton A, contains approximately 65 per cent fluorine [3]. Although the physical properties of the vulcanizates are highly dependent upon the kind and amount of fillers used, this copolymer of vinylidene fluoride and hexafluoropropylene has exhibited outstanding high-temperature fluid resistance, with a possible −65 to +600 F service temperature range [4, 5, 6, 7, 8]. The hours to brittleness are 2400 at 400 F, 2000 at 450 F, 300 at 500 F, 100 at 550 F, and 24 at 600 F [9]. At 300 F tensile strengths as high as 1100 psi and elongations greater than 100 per cent can be obtained [10, 14]. Oil, lubricant, and chemical resistance, both at room temperature and at elevated temperature, is another characteristic.

Because of the combination of heat and chemical resistance, the largest single use of Viton today has been for aircraft seals [11, 12, 13]. It is also finding applications in the chemical-processing industry as coated fabrics for protective clothing and fuel cells, hose, and tank linings.

Polyurethanes. An increasing number of commercial applications have been extended to elastomeric polyurethanes because of their inherent characteristics such as abrasion resistance and durability, good tensile and elongation, and oil, ozone, and oxidation resistance [15, 16, 17, 18].

The wide variety of raw materials and the extensive processing conditions permit the production of numerous types of polyurethane rubbers having specific combinations of properties [19, 20]. All the polyurethane rubbers have the same basic properties but it is the ability to combine certain properties, such as toughness and resilience at high hardness that distinguishes urethane rubber. Tear resistance and abrasion resistance increase with hardness. Because it absorbs less than 1 per cent moisture urethane rubber maintains a high degree of dimensional stability.

Flexible polyurethane foams based upon the reaction of a diisocyanate with a polyester or polyether, are presenting increasing competition to latex and vinyl foams because foams having a wide variety of properties may be prepared from these components [21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]. Because of the versatility of this family of foams articles of a desired form or size can be made by molding directly during the foaming reaction, or they can be shaped from slab foam [32, 33, 34]. They have superior load-bearing capacity and their hardness can be modified. The introduction of the polyether-based foams with their higher resilience insures a still greater latitude in the fabrication of cushioning articles [34]. All polyurethane foams are characterized by inertness to a wide variety of chemicals, resistance to sunlight and weathering, good aging resistance, and ability to be foamed in place [33].

In addition to cushioning materials, other applications of polyurethane foams include rug underlays, crash-protecting devices and other energy-absorption applications, and thermal and acoustical insulation [35]. Distributor prices are comparable or even a little lower than those for foam rubber [36, 37].

While the major interest in the isocyanate rubbers currently centers on the polyurethane foams, for certain purposes formulations which are castable have considerable development potential [38, 39, 40]. Cast urethane-rubber items can be produced with a hardness of 80 to 95 durometer, A-scale, without inert fillers or fabric lamination. These hard, high-load-bearing rubbers still

[1] Numbers in brackets designate References at end of paper.

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retain the elasticity and vibration-damping characteristics of unfilled natural or synthetic stocks in the 50 to 60-durometer range [20]. A thin layer of the material cast between two metal sleeves creates a drive-shaft torsion elastic spring. The urethane dampens vibration and cushions shock. What makes the use of the synthetic so advantageous in this case is its unique adhesive qualities. This permits a much smaller drive-shaft coupling and could lead to smaller drive-shaft humps in cars of the future [41].

Polyurethane polymers, processible in the liquid phase, have recently been introduced to form end products attainable by casting or pressure molding, spreading, or spraying [42].

Ethylene-Propylene Copolymers. In 1958, the Italian firm, Montecatini, exhibited in this country its rubberlike copolymer of ethylene and propylene [43, 44, 45, 46, 47, 48, 49]. Since these raw materials are the cheapest starting materials at present conceivable for a synthetic rubber there is some speculation that the copolymer will sell for less than our general purpose butadiene-styrene rubber. The over-all properties of the new synthetic, called C-23, are very similar to those of natural rubber, and superior in some respects.

At the present time this synthetic is in the semicommerical stage at the company's plant in Ferrara, Italy.

Polyisoprene Rubber. The spectacular scientific achievement of the successful polymerization of isoprene duplicating the natural-rubber molecule was first announced in 1955. During the past 2 years extensive research and development have been conducted on this natural-synthetic rubber [50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60].

Economic as well as scientific reasons have stimulated interest in finding a satisfactory substitute for natural rubber. Until the present time only natural rubber has been satisfactory for heavy-duty tires for trucks, buses, and airplanes where heat build-up is a major factor. Then too, in addition to the fact that a world-wide shortage of tree rubber has been forecast for 1960, every effort is being made to attain independence of imported rubber in the interests of national defense.

In the synthesis of this natural-synthetic rubber the two major catalysts used today are the lithium or organo-lithium compounds and the Ziegler type, a mixture of aluminum alkyl and titanium tetrachloride.

The principal differences between these two versions of synthetic rubber are the greater ease of crystallization of the Al-Ti rubber and the high molecular weight of the lithium type. The crystallizability is felt to be closely tied in with hot tensile strength. High molecular weight, on the other hand, provides improved resilience properties.

The major research efforts on this rubber have resulted in the Goodrich product "Ameripol SN" [61, 62, 63], Goodyear's "Natsyn" [51, 64, 65, 66, 67, 68, 69], Firestone's "Coral Rubber" [70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82], and Shell's "Polyisoprene Rubber" [83, 84, 85, 86, 87, 88, 89, 90].

Although the various polyisoprene rubbers are quite similar to natural rubber they are not identical with it.

Actual tire tests for certain uses such as heavy-duty tires for trucks, buses, and airplanes where high heat build-up is a factor, have confirmed laboratory data showing that this polyisoprene rubber is comparable to natural rubber for wear and for heat build-up during tire operation [61, 62, 64, 65, 70, 74]. In general durability, and in all other gages of performance, final comparative test figures have shown that the polyisoprene tires measure up to the performance of the natural-rubber tires. High-speed jet-aircraft tires made entirely with polyisoprene rubber and capable of withstanding landing speeds up to 250 mph have passed rigid durability tests that qualify the man-made rubber for jet-aircraft service [64]. These tires also successfully withstand temperatures in excess of 250 F, generated by high-speed landings.

On March 10 of this year, U. S. Rubber Company and Shell Chemical Company announced the commercial production of synthetic polyisoprene rubber at a selling price of 30¢ a pound, and the commercial production of 7.50-20 size truck tires at the same price as these tires made with the usual content of natural rubber [85]. Firestone, Goodyear, and Goodrich have pilot, semicommercial, or commercial plants built or in the process of building.

Research and development investigations on polyisoprene rubber have also been proceeding in Russia [50, 91]. First news of the Russian synthesis of natural rubber appeared in 1957. Since that time a number of Russian technical publications have appeared covering the properties and test data of their "SKI" polyisoprene rubber [92, 93, 94, 95, 96, 97, 98, 99]. Their general conclusions are that the closeness of structure of "SKI" and natural rubber accounts for the large degree of agreement in their mechanical properties. However, they state that since these rubbers are not identical there are certain differences in their properties; in some properties "SKI" will be inferior to natural rubber while in others it will be equivalent or its superior [92].

In the United States, the future of this synthetic natural rubber is dependent upon the successful development of new processes for making isoprene monomer and also its prospects against those of other newly discovered synthetic rubbers to fill the same role.

Polybutadiene. In April, 1956, Phillips Petroleum Company announced the preparation of several elastomers of controlled structure, including cis and trans-polybutadienes. Since that time procedures have been developed for making a whole series of linear polybutadienes. The form which has aroused the greatest interest in the polybutadienes is the cis-form. This form acts the most like natural rubber and although it cannot really be classed as a synthetic natural, since it is not isoprene based, it can be substituted for natural rubber in many uses [51, 55, 60, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109].

Test results of vulcanizates show low heat generation and high resilience as well as good abrasion resistance [108]. Data also show slightly lower modulus and lower tensile strength for tread stock compared to the styrene and natural rubber. However, excellent hysteresis properties equivalent to the natural-rubber control have been obtained.

In recent tire-test programs Phillips reports that its polybutadiene rubber, now called "Cis-4 rubber," out-

performed natural rubber [104]. The new rubber proved to be superior to natural rubber not only in treads made from the new rubber alone, but also in blends containing up to 50 per cent natural rubber.

Firestone has also announced a polybutadiene rubber [60, 70, 110, 111]. The product called "Diene" differs in structure from those rubbers made by using the catalyst system employed by Phillips. But the company sees little difference in performance when blended with natural Hevea rubber for tires or other products. Firestone regards Diene as a rubber extender. It feels that the product may eventually be used to replace a substantial portion of the natural rubber used in truck tires.

None of the polybutadienes is yet available commercially [112].

Halogenated Butyl. Two features of Butyl rubber which have been recognized as needing improvement are its incompatibility of cure with other elastomers and its poor adhesive properties. Desirable properties have been produced by the halogenation of Butyl rubber [113, 114, 115, 116]. Bromine seems to be the best all-around halogen for use at this time. Chlorine also can be used but it is not quite as satisfactory for most uses as bromine. Compatibility with other rubbers allows the use of bromobutyl in the inner liner in an SBR tubeless tire to give the air-holding power of the Butyl, and the adhesion and compatibility of natural rubber or SBR.

Nitrile Silicones. The continuous need for better oil resistance in rubber components operating at high temperatures has resulted in the introduction of nitrile-silicone rubber [117, 118, 119, 120, 121, 122, 123, 124, 125]. This GE general-purpose rubber combines oil resistance with the ability to maintain strength and usefulness at temperatures ranging from a subarctic −100 F to the 500 F required for modern jet aircraft. It is a 60-durometer, relatively low-modulus stock, suitable for such applications as airframe seals, boots, diaphragms, and shock mounts, and can be fabricated by extrusion molding or calendering. Other members of this family of rubbers are under development at the present time.

Organo-Metallic Elastomers. As part of a program aimed at the development of metallo-organic elastomers, products with typical rubber properties have been produced at the Army Quartermaster Research and Engineering Laboratories [126, 127, 128]. Most recent researches have been focused on organo-tin compounds. The polymers produced vary from viscous oils to tough, rubbery materials, depending on the monomer, catalyst, and polymerization system used. Products having elasticity and high stretchability have been obtained. Vulcanizing studies are under way on these organo-tin elastomers.

Adduct Rubbers. Adduct rubbers prepared by the chemical addition of mercaptans to the unsaturated bonds in diene polymers were first announced in 1957. Subsequent studies [129] have shown these materials to be extremely resistant to the effects of ozone attack even in the case of a 95 per cent saturated adduct tested without any added antiozonant. This stock withstood ozone attack for 300 hr under conditions which caused deterioration in neoprene in 1 hr and in Butyl in 20 hr.

Exposed to 300 F air oven, the adducts retained useful stress-strain properties several days longer than Neoprene, with the 95 per cent adduct matching the aging properties of resin-cured Butyl for 5 days. In the 500 to 600 F range of temperatures these adducts outperformed both Neoprene and resin-cured Butyl.

Upon exposure to gamma radiation, the adducts proved to be much more stable than natural rubber and retained their high stability over the temperature range of −120 to +200 F; natural rubber's rate of degradation increased rapidly with increased temperature in this range. A proposed application of adduct rubber has been in the construction of a giant blimp which may be the first nuclear aircraft [130]. Dacron cloth coated with adduct rubber would cover the 4.5 million-cubic foot body of the airship. The material can withstand 10^8 roentgens of radiation and has aging and diffusion characteristics equal to those of present coatings.

Deuterio Rubber. A synthetic "natural" rubber which is primarily of theoretical interest at the present time, and in which most of the hydrogen atoms are deuterium atoms has been prepared from isoprene-d_8 [63, 131]. This rubber, called D-SN rubber, can be vulcanized much like Hevea or natural synthetic rubber. Like natural rubber and unlike the butadiene-styrene rubber, it gives good tensiles in pure-gum stocks and does not require carbon-black reinforcement to develop high tensile properties.

Solid Propellants

The outstanding feature for a solid-propellant system, versus a liquid-propellant system, is its inherent mechanical simplicity, but it is only recently that it has approached the performance of the liquid ones [132, 133, 134, 135]. Solid-fuel rockets are simple in construction compared with the liquid-propellant types and do not require fuel tanks and complicated feed systems or pumps [136]. The current-interest in solid propellants for high-performance rocket motors stems largely from the development of castable composite propellants which can be case-bonded in thin-walled motor cases [137, 142].

The synthetic rubber serves as the major portion of the fuel and also serves as the matrix for holding the other ingredients together. The combined synthetic rubber, carbon black, plasticizer, curatives, and age resistor are often referred to as the binder [138, 139, 140, 141]. Processing includes such conventional steps as drying, grinding, mixing, and extruding [143]. The propellants currently available have a wide variety of properties, such as burning rates, which may vary over a 600-fold range [144]. Efforts to manufacture propellants so that they will have a high degree of reliability and reproducibility during ignition and deflagration have been successful [145, 146].

It has been stated that some problems yet to be solved before solids become effective space-vehicle launchers are those of achieving close dimensional and weight tolerances of hardware and propellant charge, and possible close tolerances of ballistic parameters and thrust termination [147].

Various elastomers may be used in the solid-fuel-propellant system [136, 148], such as butadiene-styrene rubber, Thiokol, Butyl rubber, polystyrene, polyethylene,

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and polyurethanes. The incorporation of metals such as aluminum, boron, beryllium, and magnesium has proved to be one way of boosting the performance of solid propellants [149, 150].

Adhesives

A new bonding process which utilizes partially hydrogenated polybutadiene now makes possible the direct adhesion of polyethylene to rubber, brass, or brass-plated metals [151, 152, 153]. The method produces bonds with tensile strengths up to 1000 psi, and peel strengths from 60–100 lb per in. Various ingredients are added to the partly hydrogenated polybutadiene to make it capable of vulcanization.

Bonding is accomplished at temperatures ranging from 150–232 C and at pressures of 100 psi or less, although higher temperatures and pressures may be used.

Some of its major applications include applying polyethylene insulation to wire and cable, the manufacture of printed-circuit boards, submarine-cable repeaters, coatings for tanks and plating racks, missiles, and also in bonding polyethylene uppers to shoe soles.

Ozone Resistance

Diligent research is being directed toward the protection of rubber against atmospheric ozone-cracking. Among the general-purpose and specialty rubbers in current use, some are inherently resistant to ozone but others require a chemical antiozonant for ozone resistance [154].

The nature of ozone attack is not always predictable. In studying the ozone resistance of butadiene-styrene rubber at low temperatures it was found that under low stress the ozone resistance of SBR at low temperatures is far superior to what would normally be predicted [155].

Many investigations have been and are being conducted in order to obtain a better understanding of the mechanism of ozone attack [156, 157, 158, 159, 160, 161, 162, 163, 164, 165]. As a result of research on the ozone resistance of Butyl rubber it was concluded that ozone failure time is dependent upon applied stress only when reorientation of polymer chains is possible [156]. Another test had led to the conclusion that at very low pressures cutting is caused not by ozone, but by atomic oxygen [164]. Another hypothesis is stated in which negativity of rubber, as measured by contact potentials, is correlated with actual loss in bond strength caused by ozone [160].

In comparing accelerated and natural tests for ozone resistance it has been argued that absolute correlation should not be expected since in outside tests there are influences affecting cracking behavior which are absent in indoor tests. These include sunlight, rainfall, temperature, ozone-concentration fluctuations, state of cure, polymer unsaturation, and filler and plasticizer loading [158, 159, 168, 170]. It has been observed that specimens from some stocks exposed in the late Fall of the year will go through the Summer without cracking, while specimens from the same stock exposed in late Spring will crack in a few days.

Wax has been widely used as a protective agent and several authors have studied the relative merits of various types of wax [166, 167, 169].

Among the chemical antiozonants which have been tested the N,N′-dioctyl-p-phenylenediamines have proved effective [169, 171, 172, 173]. Certain nickel complexes have been found to provide some protection [174, 175]. Wing-Stay 100, a mixed diaryl-p-phenylenediamine, has been found to act four ways to increase the useful life of rubber—as an antioxidant, and antiflex cracking agent, a metal deactivator, and as an antiozonant [176, 177, 178].

Radiation Studies

Extensive investigations have been reported during the past 2 years on the effects of radiation on the properties of classes of elastomers and specific rubbers [179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189]. The general conclusions are that the nature and degree of change depend upon a number of factors such as rate and length of irradiation time, energy of the radiation, chemical composition of the materials, initial state, type of radiation, and the environment, including such factors as stress, temperature, pressure, and so on. However, each material must be considered individually along with its intended application.

Most reports claim that natural-rubber vulcanizates offer the best over-all properties for a compound which may be subjected to gamma radiation. However, test data have shown that the adduct rubbers are much more stable than natural rubber in this respect [129].

In general, the elongation of elastomers always decreases with increasing exposure to radiation, while the hardness increases. The tensile strength is much less predictable and will vary [181]. Stretched rubber is extremely sensitive to radiation damage, manifested by stress relaxation with attendant changes in x-ray diffraction intensity and early rupture [184]. In testing various rubbers compounded with usual ingredients it was found that none of the rubbers would yield gaskets or seals capable of performing satisfactorily after being irradiated with 10^9 roentgens of gamma rays [185]. For lower dosages of radiation, satisfactory gaskets and seals can be made from several rubbers.

The separate effects of heat on the rate of radiation damage and on the physical test values do not appear to add in a simple way [186, 188]. It appears that less radiation damage results from the combination of both irradiating and testing at 158 F than the sum of the separate effects would predict.

Numerous data on the effects of radiation vulcanization on the physical and chemical properties of elastomers have been recorded which in general indicate improved aging behavior but variations in static and dynamic properties depending on such variables as compounding ingredients, radiation damage inhibitors, initial molecular weight, and environment [190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200]. The over-all picture is that radiation-cured rubber has not yet shown general physical properties comparable to those obtained through thermal vulcanization [200]. Radiation vulcanization studies are an important advance in rubber technology but the present value is an alternative route to the understanding of the reactions involved, and in the evaluation of the relationship between physical properties and chemical constitution of elastomers [197].

In June, 1959, a new rubber-based material was announced for use in atomic-powered planes and other vehicles which can shield the crew and passengers from neutron radiation [201]. The new rubber will take over the job that is normally handled by heavy concrete and water shields in stationary atomic plants. In the power units for planes, lead shields still will be required to absorb the deadly gamma rays. Preliminary tests show the rubber will withstand at least 100 million roentgens of radiation with no apparent deterioration.

High-Temperature Rubbers

Considerable progress has been made in the development of elastomers capable of withstanding service applications at temperatures in the range of 400–600 F in the presence of oils, fuels, and oxidizers. The fluorinated elastomers have offered the greatest possibilities in this specific field of application [4, 7, 202, 203, 204, 205, 206, 207, 208, 209].

The most recently introduced, designated "Fluorel," was reported at the Fifth Joint Army-Navy-Air Force Conference on Elastomers, October, 1958 [210, 211, 212]. Designed for use at 400 F, the elastomer chemically resists such fluids as diester, silicate ester, or petroleum-based lubricants and hydraulic fluids, JP-type aromatic fuels, HEF or Hi Cal fuels, and powerful oxidants such as 90 per cent hydrogen peroxide and red fuming nitric acid. One of the most important properties of the elastomer for mechanical-goods application, such as seals and closures, is its resistance to compression set.

The use of silicone rubber in applications where temperatures go as high as 600–700 F is based on its superiority with respect to permanent set and compression set under severe operating conditions [213]. Data on the behavior of silicone rubber in sealed systems at high temperatures show that proper compounding and fabrication techniques are critical factors.

Latex-Rubber Foam

The latex-rubber-foam industry has now advanced to the status where it is using a higher percentage of synthetic rubber latex, and in some cases up to 100 per cent in the manufacture of foamed rubber, resulting in more uniform processing and lower cost [214].

Latex foam of 100 per cent synthetic rubber composition has improved long-term aging properties. Such foam has excellent flex life and the hysteresis and resilience values are very good, being equivalent to those of 100 per cent natural-rubber foam. Stress-strain properties of 100 per cent synthetic rubber foam are inferior to those of natural rubber foam but they are adequate for most cushioning applications. Also, the low-temperature properties are not quite as good as those of the natural-rubber foam, but they are substantially better than those for other types of elastomeric foams presently being produced. The main advantage of an all-synthetic rubber foam is that it gives greater assurance of product price stability.

A new apparatus has been described with which it is possible to determine the volume per cent of open and closed cells in both rigid and flexible foams [215]. It is stated that the test takes only a few minutes and requires only three single calculations. The test has been applied to many types of foams including those made with urethane, polystyrene, vinyl, neoprene, and other synthetic and natural rubbers.

Tires

Although wire-cord tires are not new, new construction techniques have made possible cooler running aircraft, truck, and bus tires that give up to 100 per cent more mileage on the original treads [216, 217, 218]. The new tires have wire-reinforced walls and three plies of fine wire mesh under the tread instead of the previous single-ply tread. It is this reinforcement under the tread that results in minimum friction between the road surface and the tread, and consequently greatly improved wearability. These tires have been commercially available since July, 1957.

On May 12, 1959, the all-Butyl rubber tire was publicly introduced [219, 220, 221, 222, 223]. The Butyl tire is claimed to be outstanding in its shock-absorbing qualities and in its smoother riding, safer, and quieter riding qualities. Only auto tires are being made at the present time but the Army has approved Butyl rubber for use in military truck tires. Pricewise, Butyl tires are reported to be about 20 per cent more costly than a standard-type synthetic, but still less expensive than the premium types.

Initial tests performed on a new airless tire, filled with urethane foam, indicate that the tire will not deflate even after extensive mutilation [224, 225, 226]. The tire casing is filled with "polyrubber," a controlled-density urethane foam of special formulation, forming a permanent bond with both casing and metal rim. There has been no indication when the new airless tire will be put on the market.

A wire brushlike tire, containing no rubber, no fabric, and needing no inflation, is capable of withstanding temperatures from 1000 to 2000 F that might be encountered by a space craft re-entering the earth's atmosphere [227]. The tire which has twisted-wire treads that look like a wire polishing wheel, weighs about 40 lb. The wire tire has a number of advantages over the simple skid pads that are used on some recoverable missiles. It absorbs runway irregularities better, doesn't get so hot, and gives much better directional and braking control.

"Plioprene," a luxury rubber for tires, is a modified butadiene-styrene rubber which will provide a softer ride with less squeal, vibration, road rumble, and highway expansion-joint thud [228]. Research is being continued to try to improve the tread-wear characteristics which are not as good as those of some other synthetics.

American Airlines is service testing 30 tubeless tires having fabric in the tread instead of 100 per cent rubber [229]. Tires of this type are said to run $^1/_3$ cooler than conventional models.

The development of a satisfactory adhesive for Dacron and rubber has resulted in building tires with Dacron cord [230, 231, 232]. It has been reported that tires built of these materials give increased mileage and an improved ride. There has been no indication when Dacron tires will be available commercially.

In addition to tire materials, design studies and in-

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vestigations on the rolling resistance of tires, are contributing to road comfort and safety [233]. Empirical and theoretical studies show that tire wear depends very largely on the cornering forces which tires are required to develop [234, 235, 236, 237, 238, 239]. As a result of investigations on frictional temperature rises on rubber, one conclusion is that, in the experimental velocity range, the frictional temperature rises increase approximately proportionally to the square root of the sliding velocity [240]. Under cornering conditions it has been stated that speed has little effect on the tire-ground frictional properties except in those cases where bodily slippage occurs [241]. A mathematical appraisal based on theories of heat conduction has led to the conclusion that the abrasion which occurs under normal driving conditions is purely mechanical [242]; only under extreme conditions, such as very rapid acceleration, or in the case of locked wheels, would there be the likelihood of high frictional temperatures, which lie above the decomposition temperature of rubber.

Conclusion

This review paper has covered only those developments which, in the author's opinion, are considered outstanding. However, these items represent only a small percentage of the ever-increasing volume of research and development which is being conducted and reported in the rubber industry.

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RELATIVITY and the mechanical engineer

Perhaps relativity will never figure in your calculations. Call this article mental

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THE THEORY of relativity, developed principally by Einstein early in the twentieth century, has only recently become of more than academic interest to mechanical engineers. The science and practice of mechanical engineering frequently involve the Newtonian concepts that mass is a fundamental constant for a given body, that force equals mass times acceleration, that kinetic energy equals half the mass times its velocity squared, and that time passes at the same rate everywhere. Einstein's relativity, now well reinforced by experimental evidence, shows all these concepts to be only approximations that are good for ordinary situations in mechanical engineering, but which can be grossly in error when the velocities involved are extremely great.

High Velocities in Engineering

The tremendous velocities that call for the engineer to consider relativity occur in two principal fields, the motion of subatomic particles such as electrons, and the motion of space vehicles of the future. These fields have recently become of interest to mechanical engineers.

While research with subatomic particles is primarily the domain of the physicist, the necessary "particle accelerators" such as "cosmotrons" have become so huge that their design is largely a mechanical-engineering problem, and some understanding of the behavior of the high-speed particles becomes important to the mechanical designer. Betatrons and Van de Graaff generators, which accelerate electrons far into the region where relativity becomes important, have become engineering production tools as sources of extremely penetrating x rays for the radiography of thick metal parts.

The second field, space travel, involves many doctrines including mechanical engineering. Nuclear or ionic propulsion of space vehicles involves high-velocity particles, and it is presumed that eventually space vehicles themselves will travel at velocities that will introduce significant relativistic effects. The design of space vehicles, their propulsion, and their planned usage are all matters of professional interest to engineers.

Basic Concept of Relativity

The fundamental idea of relativity has been stated by Einstein as follows: "The laws of physics must be of such a nature that they apply to systems of reference in any kind of motion" [1].[2] This means that only the motion of any given body relative to other bodies in the universe has any basic significance, and that there is no real meaning to the term "absolute motion" because nothing in the universe is known to be stationary. Newton's well-known laws, which are based on the concept of absolute motion, are found to be only good approximations at best, accurate though they may be for most engineering situations.

Verifications of Relativity Theory

The limitations of the present discussion do not permit delving far into the actual theory of relativity. Rather, emphasis herein is placed on the significant differences in the behavior of physical systems, as predicted by relativity and by Newtonian theory, respectively.

Most of the experimental verification of relativity has been astronomical, beginning in 1919 with observation (during an eclipse) of Einstein's prediction that starlight grazing the edge of the sun should be bent through 1.75 seconds of angle by the sun's gravitation [2]. Relativity theory also provided the explanation [3] for a previously observed but unexplained slow rotation of the orbit of the planet Mercury (in addition to the rotation known to be caused by other planets). Of more interest to the engineer are the relativity predictions that the velocity of one body or particle relative to another can never exceed the velocity of light in a vacuum, and that the mass of any given body or particle increases toward infinity as its velocity approaches that of light. Thus the mass of a body is not a constant property, as Newton thought it must be. This fact, in the case of electrons, protons, and other particles, has become a common observation by physicists, and is a key factor in the design of particle accelerators such as betatrons and cyclotrons. It may some day have a bearing on the behavior of ultrahigh-speed space vehicles.

The relativistic variation of mass with velocity is

$$m = m_0/[1 - v^2/c^2]^{1/2} \qquad (1)$$

where m is the "relativistic" mass of the body in motion, m_0 is its mass when at rest, c is the velocity of light in a vacuum, and v is the velocity of the body (relative to the observer). Thus, when a particle in an accelerator reaches nine tenths the velocity of light (as commonly occurs), its mass becomes more than twice its mass when at rest. If the accelerating force is maintained constant, the acceleration becomes less and less, approaching zero as the velocity approaches that of light. Accordingly, no amount or duration of rocket thrust could cause a space-ship to go quite as fast as light.

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Based on a paper presented at Seattle, Wash., October 7, 1959, at a meeting of the Western Washington Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] Numbers in brackets designate References at end of paper.

diversion. But there are mechanical engineers who must go beyond Newton's "laws."

Velocity Addition

If no amount of thrust could accelerate a rocket to or beyond the speed of light, why might not a rocket be accelerated to say nine tenths the speed of light, and then let it fire forward another rocket at half the speed of light relative to the first rocket? Strangely enough, relativity shows that, even then, the second rocket would not exceed the speed of light. The mechanical engineer is used to the simple vector addition of velocities in such cases, but at extremely high speeds this vector addition is not strictly correct. Relativity shows that the velocity of the second rocket, relative to the observer, is given by the expression, $(v_1 + v_2)/(1 + v_1v_2/c^2)$, where v_1 is the velocity of the first rocket relative to the observer, v_2 is the velocity of the second rocket relative to the first, and c is the speed of light. This expression shows the final speed of the second rocket to be only 97 per cent of the speed of light.

Kinetic Energy

Probably the most publicized equation of Einstein's relativity is:

$$E = mc^2 \qquad (2)$$

where E is the total energy in a body, m is its relativistic mass, and c is the speed of light in a vacuum. For a body in motion, if the mass m is written in terms of the "rest mass" m_0, Equation (2) becomes (by binomial expansion):

$$E = m_0c^2/[1-v^2/c^2]^{1/2} = m_0c^2 + \frac{1}{2}m_0v^2 + \frac{3}{8}m_0v^2\,(v/c)^2 + \ldots\ldots \qquad (3)$$

The m_0c^2 term in this last expression is the "atomic energy" in the mass when it is at rest. It can be seen that the second term, $^1/_2\, m_0v^2$, is the engineering expression for kinetic energy, whereas the expression shows that the kinetic energy actually includes additional terms that are negligibly small at ordinary velocities but not when the velocity approaches that of light.

Acceleration Force

Another consequence of the variation of mass with velocity is the fact that the engineering expression, that force equals mass times acceleration, is only an approximation that is accurate at ordinary velocities. Relativity shows that actually there must be an additional force component that is appreciable only at very high velocities, to take into account the changing mass as the speed changes [4].

Passage of Time

Still another aspect of relativity is the fact, hard for most engineers to believe but almost universally accepted by physicists today, that time passes at different rates on bodies moving at different velocities relative to the so-called "fixed stars" [5]. Tremendous velocities are required before this time effect should become significant, but subatomic particles of today and the probable space vehicles of the future involve such velocities.

This situation has been publicized principally with regard to the so-called "clock paradox" or "twin paradox" of space travel [6]. If one of twin residents of the earth were to take an ultrahigh-speed space journey to the nearest star and back, it is now pretty well agreed (but not quite universally) that upon his return he would be "younger" than the twin who stayed home. That is, his clock would have indicated less elapsed time, his heart would have beat fewer times, and he would have more years of life expectancy left. If the traveling twin had gone near enough to the speed of light, for what seemed to him to be a year, he might return to find that a thousand years had elapsed on earth. However, it is to be emphasized that this time-slowing effect would not cause the traveling twin to think that he was living any longer or slower than he would on earth.

If man should ever become able to build a space-ship that can closely approach the speed of light, there is fundamentally no limit to the distance that it could traverse within say a year of the passengers' lives. If a given star is a thousand light-years from the earth, it would indeed take more than two thousand years of earth-time for such a space-ship to travel to that star and back. However, in the slowed-down time scale of the space-ship passengers, the round trip might take less than a year.

The time-slowing effect of high velocity has been checked in the case of moving radioactive subatomic "mesons," whose rate of radioactive decay has been observed to vary with velocity in accordance with the time-slowing predicted by relativity theory [7], but this subatomic behavior may not be convincing to the engineer concerned with future space-ships.

Centrifugal Force

The foregoing discussion has noted some of the consequences of the theory of relativity that can be involved in the present or future work of men in the mechanical-engineering profession. There are other aspects of relativity which, while not actually affecting the designs or

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decisions of the engineer, do have a bearing on some of the concepts that he utilizes. For example, consider a flywheel which bursts from excessive speed. The mechanical engineer ascribes this failure to centrifugal force, which is an inertia force associated with the radial acceleration of the flywheel rim. However, since relativity says that only relative motion is significant, it should be possible to assume that the flywheel is motionless and that the rest of the universe is revolving around it. But then what could cause the wheel to burst?

Einstein [8] and others [9] have shown that what we call centrifugal force is basically a gravitational effect caused by the relative acceleration of the given body and the surrounding bodies. Thus it makes no difference whether we consider the flywheel stationary, the rest of the universe stationary, or neither, so long as the relative motion is properly considered.

The significant "surrounding bodies," strangely enough, are not nearby masses or the earth itself, but the combined total of distant stars, whose tremendous mass makes up for their great distance away. Relativistic calculations of the gravitational effects of the distant stars on the rotating flywheel show close agreement with the centrifugal forces as calculated by the conventional engineering formulas, for rotational speeds within the limits of engineering situations. Even a small hollow body, rotating rapidly, creates within itself a radial gravitational "centrifugal field" that would tend to burst a small stationary flywheel placed in this field, but the field would be too weak for its presence to be detected by any currently available means [8].

Coriolis Force

If a man stands still on a rotating horizontal disk, such as a merry-go-round, he notices that centrifugal force tends to make him fall outward. If he walks along a radius of the disk, he notices also a tendency to fall sidewise, and it is sometimes said that a "Coriolis force" is acting on him.

This Coriolis force is an inertia force much like centrifugal force, except that it results from the man's tangential acceleration as he changes his radius from the center of the disk. Relativity explains the Coriolis force in much the same way as centrifugal force. Any rotating hollow body creates within itself a "Coriolis field" (as well as a centrifugal field), which would tend to deflect tangentially any radially moving mass contained within the hollow body [8]. Correspondingly, the mass of the distant stars has a Coriolis effect on the man walking radially on the rotating disk.

Inertia Force

Centrifugal and Coriolis forces are just two types of inertia force which relativity shows to be basically gravitational phenomena. Inertia in general, according to relativity, is one and the same as gravitation. If a man is in a closed room, he cannot tell whether the room is at rest on earth, or whether it is traveling through outer space with a vertical acceleration of 32 ft per sec squared (relative to the fixed stars). Any experiment that he might conduct within the room would behave the same in either case.

For any given body, its weight is a measure of gravitation and its mass is a measure of inertia. There is no obvious relationship of mass to weight. Then, for several bodies at the same location on earth, why should their respective masses and weights be in the same proportion? Newton noted the proportionality of mass to weight, but expressed wonder at why it was so. Einstein, in his theory of relativity, showed that mass must be proportional to weight (at a given location), since he found that inertia and gravitation are fundamentally equivalent.

Abstract Concepts of Relativity

Finally, it may be well to mention some of the more abstract concepts of relativity that are particularly difficult to visualize, but which are essential to any real understanding of the theory. While the engineer likes to think of space as three-dimensional, relativity shows that it should be considered as a four-dimensional "space-time" that is impossible for most persons to visualize. The universe is finite in size but is unbounded, as is the surface of any sphere. Each mass in the universe causes the space around it to be "curved," and it is this curvature of space that accounts for gravitation [10].

The velocity of light is the same relative to anything that it strikes, regardless of the speed of the light source or of its target. This phenomenon can be ascribed to the fact that, in the four-dimensional geometry of the universe, light has effectively infinite velocity [11], which would thus be infinite relative to any target not having infinite velocity itself.

Lastly, it is to be noted that gravitation, as well as velocity, affects the rate of passage of time, so that a man on a mountain top lives a little faster than a man at sea level.

Conclusion

The present article has endeavored to point out some aspects of the theory of relativity that are or will eventually be of real concern to the mechanical engineer, as well as some of the relativistic concepts that may affect the thinking of the engineer if not his actions. A little study of relativity by the mechanical engineer, besides offering some mental diversion, may well serve to broaden his outlook on the more mundane but no less difficult technical problems encountered in his profession.

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Fig. 1 An airfoil in level flight, with smooth flow of air the laminar layer of air flow. The lift breaks sharply. Fig. 2 Airfoil in stalled position. Turbulence has destroyed tions. The smooth flow lines are restored. The resulting lift at maximum angle of attack permits slow landing and take-off. Fig. 3 The perforated wing with suction through the perfora-

Fig. 1 Fig. 2 Fig. 3

Turbulence—and hence stall—has been controlled by suction pulling air through perforations in the wing's upper surface. Result: Slower take-offs and landings.

WINGS THAT WON'T STALL?

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An area of increasing research in the aircraft industry deals with the development of means and methods by which an airplane may take off and land utilizing a small area.

One concept is the development of high-lift devices which will give the aircraft the required lift from the airfoil at slow flying speeds.

The lift of an airfoil in normal flight is dependent on the relative flow of air over its surface as the aircraft is propelled, Fig. 1. As the velocity of the aircraft is decreased, the angle of attack of the airfoil must be increased in order to maintain the required amount of lift. If the velocity of the aircraft is decreased to an extent where an increase in the angle of attack will no longer result in sufficient lift, the airfoil is said to be in a "stalled" position, Fig. 2. At this angle of attack, the resulting turbulence has destroyed the laminar layer of airflow resulting in a loss of lift.

If a means could be found to maintain a turbulence-free, smooth flow of air when the angle of attack is at a maximum, the forward speed of the airborne aircraft could be reduced during take-off and landing so that a minimum of ground run would be required.

Boundary-Layer Control by Suction

This required intactness of the boundary layer may be obtained by suction through distributed perforations. The upper surface of the airfoil is perforated and air is sucked through with an air pump. This action causes the laminar layer to adhere to the surface eliminating the turbulence and resulting in smooth flow lines, Fig. 3.

This is not a new principle. In 1904, Professor Prandtl, the renowned authority on fluid dynamics, conducted a simple experiment[1].[2] Into a slow flowing channel of water, he placed a cylindrical section. By sprinkling mica flakes on the surface of the water, he observed a flow pattern which showed considerable turbulence on the back side of the cylinder. He then

Condensed from a paper entitled "Boundary-Layer Control by Suction Through Distributed Perforations," reporting on experiments conducted by the Aerophysics Department of Mississippi State College. The paper won the ASME's Old Guard Prize for 1959. The Old Guard Prize is an engrossed certificate and $150 awarded annually to the winner of the National Contest of Student Members who have won the First Prize at each of the twelve Regional Student Conferences. The National Contest was held at the Semi-Annual Meeting, St. Louis, Mo., June 14–18, 1959, of The American Society of Mechanical Engineers.

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Fig. 4 First experiments, on the wing of a TG-3A sailplane. Electrically driven pumps created suction, drawing air in through perforations in the upper surface of the wing.

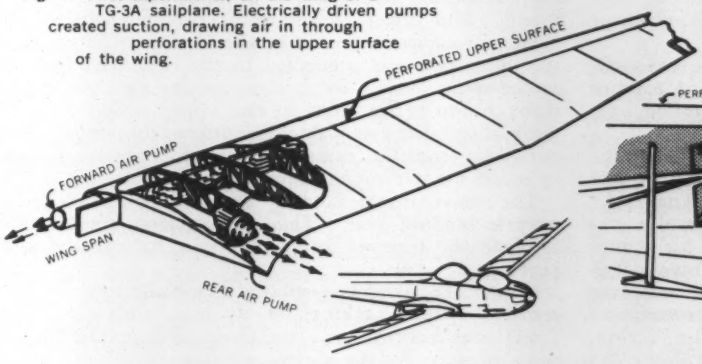


Fig. 5 The flow diagram of the installations on the modified Piper L-21A. Double glass in the windshield forms a duct from wing roots to blower. Exhaust air is directed over the engine.

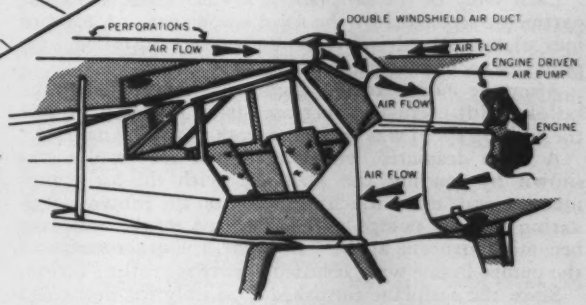
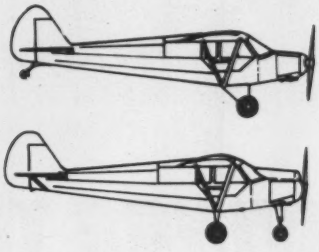


Fig. 6 The modified L-21A. The suction pump, mounted in front of the windshield, is driven by a vee belt from the engine. The standard landing gear has been replaced by a nose-wheel layout, for landing and take-off tests. No modifications were necessary for the control surfaces.



replaced the cylinder with one having a slot cut lengthwise through the convex walls. A syphon was installed to evacuate the water inside the cylinder causing an inward flow of water through the opening. With the slot positioned on the downstream side of the cylinder, it was noted that the flow pattern no longer displayed the previous turbulent separation.

Considerable study has been completed, particularly in Europe, investigating the control of boundary layer by placing these suction slots spanwise in the upper surface of a wing. Resulting data have shown conclusively that, while the slots are effective, a very large amount of suction power is required [2].

Since 1953, work has been conducted by the Aerophysics Department of the Mississippi State College investigating boundary-layer control by suction through distributed perforations. A portion of this work is being conducted under a research contract awarded by the Office of Naval Research with the sponsorship of the United States Army. The contract is being fulfilled by a team under the direction of Dr. August Raspet, the chairman of the Aerophysics Department.

Trial on a Sailplane

Initial work was conducted on a college-owned Schweizer TG-3A sailplane. Over 600,000 holes of 0.030-in. size were drilled and punched through the plywood and fabric upper-wing surfaces.

To compensate for the weakening effect of the perforations, Fiberglas was bonded to the wing. Experiments showed a ten per cent increase in strength over the original surface.

Each wing of the sailplane is divided into two compartments separated by the solid wood spar. A total of four electrically driven air pumps were installed, one pump for each compartment, Fig. 4.

After the modifications, flight tests revealed that the sailplane lift coefficient increased from 1.38 to 2.28, and the stalling speed was decreased from 44 to 29.8 mph [3].

A more dramatic demonstration of the results was shown by landing the sailplane with the air pumps inactive and, upon touching down on the runway, activating the air pumps which resulted in the sailplane becoming airborne again. In flight, the deactivation of the pumps in one wing resulted in a strong rolling action.

Since the sailplane furnished data only for flight and landing conditions, a powered aircraft was required to investigate boundary-layer control for the take-off and climb conditions.

The United States Army, under the bailment program, delivered to the Mississippi institution a Piper L-21A Super Cub liaison airplane. Manufactured by the Piper Aircraft Corporation of Lock Haven, Pa., the L-21A is a high-wing, two-place, light airplane equipped with a conventional landing gear. The airplane has an all-metal structure with fabric covering, and is powered by a Lycoming O-290 air-cooled engine producing 125 hp.

Converting a Powered Plane

Engineering considerations for conversion of this airplane to a suitable test vehicle could be divided into two major parts. First, the selection and design of a proper air pump and accompanying air ducts. Second, the adaptation of an undercarriage more suited to the extreme pitch attitude of the airplane during take-off and landing.

An air pump was designed, constructed, and mounted directly over the engine compartment. Vee-belts transmitted power from the propeller shaft to the air pump. The obstructing fuel tanks were removed from the wing and were replaced by a fuel tank placed in the baggage compartment. This location also helped offset any change in the center of gravity due to the weight of the air pump.

To form an air duct from wings to air pump, the original windshield was replaced by a double-piece windshield. The lower extremity of this windshield air duct was connected to the intake of the air pump, and the upper end was connected to the air outlet located at the wing roots. By this means, the air was drawn through the perforations in the upper surface of the wing, through the windshield air duct to the pump. The outlet air from the pump was directed over the engine cylinders for cooling purposes, Figs. 5, 6.

The conventional landing gear was replaced by a tricycle landing gear. This arrangement afforded the airplane the required angle of attack for take-off and landing.

The modified airplane displayed no violent flight characteristics. When taking off at minimum speed the directional control was sufficient. No modifications were necessary for the control surfaces.

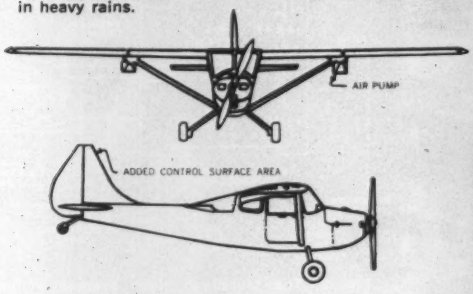


Fig. 7 A Cessna L-19A served for advanced tests, this time with suction pumps independent of the main engine. Fin and rudder were increased for additional directional control of low flight speeds. Dust proved no handicap to the system. Excellent flights were obtained in heavy rains.

Reduction in Stalling Speed

Data from the flight tests showed a reduction of stalling speed from 44 mph to 28 mph. In addition, the take-off distance over a 50-ft obstacle was reduced by 42 per cent [3].

Since the L-21A employed an air pump driven by the aircraft power plant, in case of a power failure not only the propulsion is lost, but also the boundary-layer control. This is also true to a certain degree when the power is reduced for a normal glide. Therefore the full potential of boundary-layer control cannot be exploited with this system and another test vehicle was required.

The United States Army furnished a Cessna L-19A liaison airplane. This airplane is manufactured by the Cessna Aircraft Corporation of Wichita, Kansas. The L-19A is a high wing, all-metal airplane with a conventional landing gear, and powered by an air-cooled Continental 0-470 engine producing 213 hp. Modifications for the test vehicle included an air-suction system and certain changes in the control surfaces.

The air suction is obtained from hydraulic-turbine-powered air pumps. One pump is mounted mid-span under each wing, Fig. 7. Hydraulic pressure is maintained at 2000 psi from an engine-driven hydraulic pump. The system may be turned on or off at will, by the pilot.

When the airplane's engine is "shut off" to simulate a power failure, the propeller continues to "windmill" as the plane glides through the air. This windmilling action gives the engine sufficient revolutions to operate the hydraulic pumps and to provide sufficient hydraulic power. (In the previous plane, the L-21A, the windmilling engine did not provide enough power for the pump.)

Additional surface area was added to the vertical fin and rudder to facilitate directional control of the aircraft during minimum flight speed.

Effective Boundary-Layer Control

The modified airplane is stable in flight and displays unusual slow-flight characteristics. The effectiveness of the boundary-layer control may be demonstrated by the pilot during flight by alternately performing the maneuvers, first with boundary-layer control on, then with the system shut off. Modifications and flight tests for the modified L-19A are still in progress, and the data obtained have not been released for the general public.

All of the mentioned test vehicles have operated under both dusty and damp conditions, and the only maintenance required for the perforations in the wing surface was an occasional brushing with a vacuum cleaner. Flights through heavy rain showed no performance effects on the boundary-layer control system.

To cope with the tedious task of producing the multitude of wing perforations, two portable machines were developed [3]. The first machine is an electrically driven automatic pricking device for use on fabric surfaces. This machine produces holes at the rate of 10 per sec. The second machine is for use on metal surfaces. It is an automatic air-turbine driven drilling machine capable of drilling 5.2 holes per sec through 0.032-in. aluminum alloy plates [3].

Conclusion

From the experiments conducted, it was found that the suction power requirements for a distributed perforation system are much less in comparison with the single slot system.

In addition, the distributed perforation system did not create any severe problems in trim when employed for stall control.

The information obtained from these experiments may be applied to similar flow control problems in turbulent boundary layer.

Acknowledgment

The author wishes to express his appreciation to Dr. August Raspet, Aerophysics Department, Mississippi State College, and his staff for the data and information furnished, and to Professor Harry L. Kent, Jr., Mechanical Engineering Department, University of Texas, for his aid and encouragement during the preparation of this paper.

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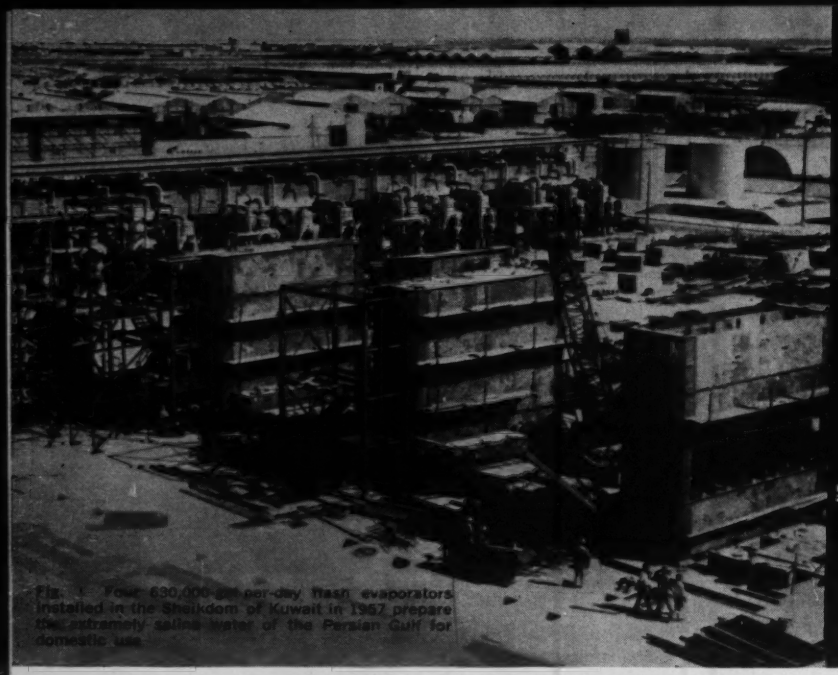


Fig. 1 Four 630,000-gal-per-day flash evaporators installed in the Sheikdom of Kuwait in 1957 prepare the extremely saline water of the Persian Gulf for domestic use

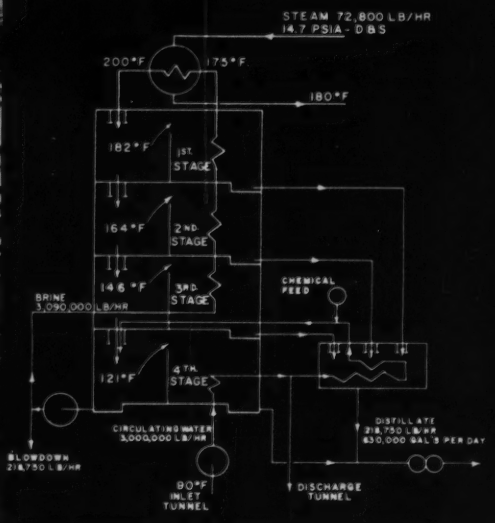


Fig. 2 The four-stage flash evaporators used in Kuwait were unique in utilizing a recirculation system. The successful use of these plants indicates that large-scale flash-distillation plants are a practical means of producing large quantities of fresh water from the sea.

FLASH EVAPORATORS

By E. F. Stalcup,[1] E. F. Coxe,[2] and R. L. Coit,[3] Westinghouse Electric Corporation, Lester, Pa.

Four 630,000-gal-per-day flash evaporators were installed in the Sheikdom of Kuwait during 1957 to prepare the extremely saline water of the Persian Gulf for domestic use. These units, Fig. 1, supplement the 2½-million-gal-per-day submerged-tube-evaporator installations which had been made by the author's company in 1952 and 1955.

The plant was the result of a serious study of direct-contact or flash-type evaporation, regarded as a greatly simplified design in comparison with the multiple-effect shell-and-tube evaporators with which the company has had considerable experience in the past several years. The laboratory model tests, which were conducted as an initial phase of this investigation, were reported in 1957.[4] As a second step in the development of commercial flash evaporators, a moderate-sized two-stage pilot plant was designed, built, and shop tested. Sea water was trucked 100 miles from Cape May, N. J., to the company plant just south of Philadelphia, in order to verify all aspects of the design and to determine the scaling effects of this type of plant.

It was found that, for a top-stage, water-treatment level of 200 F, scaling could be almost entirely eliminated by proper chemical treatment of the incoming feed.

One of the new flash-type units at Kuwait has already accumulated over 7000 hr of operation without the necessity for cleaning any surfaces, and present indications are that continuous operation can be maintained without cleaning for periods in excess of one year.

A unique feature of these units is the use of a recirculation system, Fig. 2. Sea water passes through the 4th-stage condenser and, except for a portion which is used for make-up, is discharged to waste. In the recirculation system, double-strength brine is circulated through the stage condensers where it is successively heated by steam from each stage, condensing on the outer surfaces of the tubes. After passing through the various stage condensers, the brine is heated to 200 F in a heat exchanger by low-pressure extraction steam (approximately atmospheric pressure). The brine is then introduced in the first-stage flash chamber where the reduced pressure flashes approximately 2 per cent to vapor. This process is repeated in the successive stages until the brine in the 4th stage is at 121 F.

Equilibrium is maintained by blowing down concentrated brine at a rate of one half the feed rate with the distillate accounting for the other portion of the feed. The make-up feed is taken from the 4th-stage condenser discharge, and after passing through a heat exchanger is introduced into the 4th-stage flash chamber. The heat source for the make-up is the distillate from the first three stages which is flashed in a common chamber to heat the feed. The deaeration of the incoming feedwater minimizes the scaling tendency of the brine.

An additional benefit of the effective deaeration is that the corrosive action of the brine is reduced, permitting carbon-steel plate materials to be used. However, copper-nickel tubes and tube sheets were used in

[1] Senior Negotiation Engineer, Heat Transfer Department.

[2] Development and Application Section, Heat Transfer Department. Assoc. Mem. ASME.

[3] Engineering Manager, Development and Application Section, Heat Transfer Department. Mem. ASME.

[4] R. L. Coit and Y. S. Touloukian, "Experimental Flash Evaporator," *Power*, February, 1957.

Contributed by the Process Industries Division and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of The American Society of Mechanical Engineers. Condensed from Paper No. 59—A-203, originally entitled "Flash Evaporators for the Production of Boiler Make-Up in Power Plant Cycles."

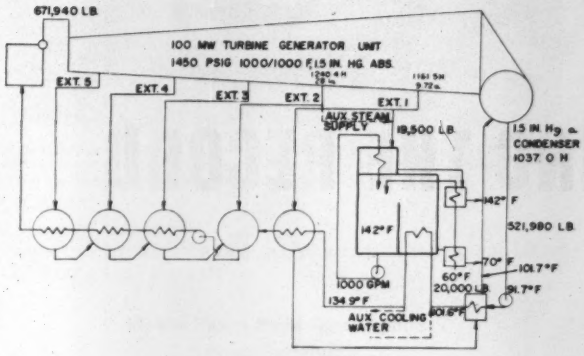


Fig. 3 A flash evaporator can be incorporated into a power-plant cycle by taking its heat from the first extraction point and draining its product into the condenser

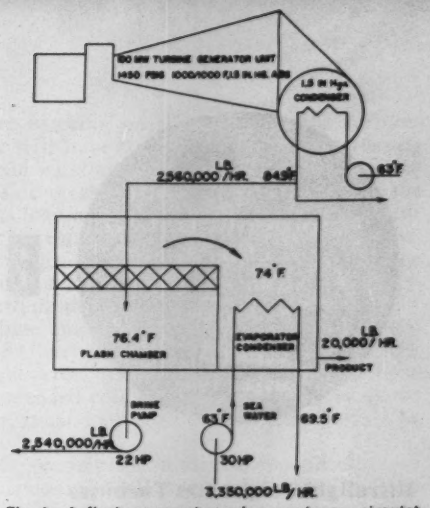


Fig. 4 A flash evaporator using condenser circulating water which could be incorporated into the power-plant cycle of a seaside station

the Kuwait units and considerably more experience would be required before steel would be substituted for the copper-nickel tubes and tube sheets.

The successful operation of these plants indicates that large-scale, flash-distillation plants are a practical means for producing large quantities of fresh water from the sea. The use of only four stages was indicated by the availability of essentially free, waste natural gas; but it should be noted that flash evaporators have no limitation on the number of stages that can be utilized. The heat transfer to the tubes occurs by condensing rather than boiling, and no minimum temperature difference is required for high heat-transfer coefficients.

For many years, submerged-tube-type evaporators were the standard means of obtaining sufficiently pure boiler make-up feedwater in steam power plants. However, the use of higher pressure and temperature cycles requires boiler feedwater of increasingly higher purity. The separation devices available could not, in many instances, produce the required purity so that demineralizers became more widely used. During recent years, marked improvement in separator efficiency has again enabled evaporators to provide water of the desired purity with many manufacturers guaranteeing 0.25 ppm and less in the distillate from 3000-ppm shell concentration.

The use of flash evaporators in power-plant cycles shows promise as a competitive device for producing high-purity boiler feed with minimum steam consumption. A flash evaporator might be incorporated into the cycle by taking its heat source from the first extraction point and draining its product into the condenser, Fig. 3.

Location of the flash evaporator in this manner has many advantages, including: (*a*) The reduction in scaling tendency which results from lower temperature operation of the evaporator; (*b*) effective deaeration of the boiler feed make-up in the evaporator, since noncondensables are removed successively in each stage; and (*c*) a reduction in turbine heat rate. Calculations were made on a 100-mw turbine-generator set cycle to show the effect on the turbine heat rate of a submerged-tube evaporator and a flash evaporator at 3 per cent make-up. The steam conditions were 1450 psig, 1000/1000 F, $1^1/_2$-in. Hg. The cycle heat rate with the flash evaporator, Fig. 3, was less by 32 Btu per kwhr than the cycle heat rate with the submerged-tube evaporator. It is realized that in normal operation the make-up will ordinarily be in the range of 0.5 to 1 per cent and that for this condition the difference will be proportionately reduced. The flash evaporator can produce and send to storage 20,000 lb per hr of water with a resulting increase over the no-evaporator cycle heat rate of less than 0.5 Btu per kwhr.

The versatility of the flash evaporator is increased when provisions are made for several alternate methods of operation. Large quantities of make-up can also be produced at part turbine load by obtaining the supply steam from a higher-pressure extraction point. With the addition of an auxiliary cooling-water system for the bottom-stage condenser as shown by the dotted lines in Fig. 3, the evaporator can be made to operate independently of the turbine.

A scheme for incorporating the flash evaporator into power-plant cycles which is especially adaptable for sea-side stations is shown in Fig. 4. In this arrangement the condenser is used as a heat source for the evaporator and relatively large quantities of water are produced for station use in addition to boiler make-up. Warm condenser circulating water, at 84.9 F, flows into a chamber where the saturation temperature is 76.4 F. The resulting vapor passes up through a wire-mesh separator and then into the evaporator condenser. The energy charge for this water is only that required to operate the pumps, since the heat source is warm condenser circulating water. This extremely compact unit should find wide application in isolated power stations which do not have a source of fresh water.

As a result of extensive testing recently completed, guarantees of 0.25 ppm are being made when using sea water for evaporator make-up. This makes the flash evaporator an attractive means of providing make-up for even the highest pressure boilers, regardless of the amount of impurities in the available water supply.

Summary

1 Flash evaporators have been shown to be a practical means for producing large quantities of potable water from sea water that will be increasingly applied.

2 Flash evaporators can be used to produce high-purity make-up feedwater either as a part of the regenerative cycle or as a separate device.

3 The use of flash evaporators in power-plant cycles results in an improvement in the heat rate when compared with single-effect, submerged-tube evaporators.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Ultralightweight Gas Turbines

A NEW line of ultralightweight gas turbines ranging in output from 50 to 20,000 shp with the high power-to-weight ratios and the compact size of aircraft jet engines will complement General Electric's established family of land and marine gas turbines.

They are designed for application where mobility and small size are required.

Two models presently offered have been selected for marine and industrial applications or feasibility testing in the field. They are the Model 240, rated at 20,000 shp, and the Model 720/722 with a 900-shp output. Units with other horsepower ratings are expected to be announced later.

Model 240 incorporates the basic gas generator used on the company's J79 military and CJ-805 commercial jet engine. The Model 240 weighing approximately 5500 lb and operating on several types of fuel will serve as primary propulsion on an 80-ton hydrofoil boat being built for the Maritime Administration by Dynamic Developments, Inc., an affiliate of Grumman Aircraft. The high-speed craft will be designed to cruise at more than 60 knots.

Designed around the company's T58 turboshaft engine, the Model 720/722 will enter field test programs during 1960 as a drive for an oil-well fracturing unit and as a gas-compressor drive in a main-line pumping station.

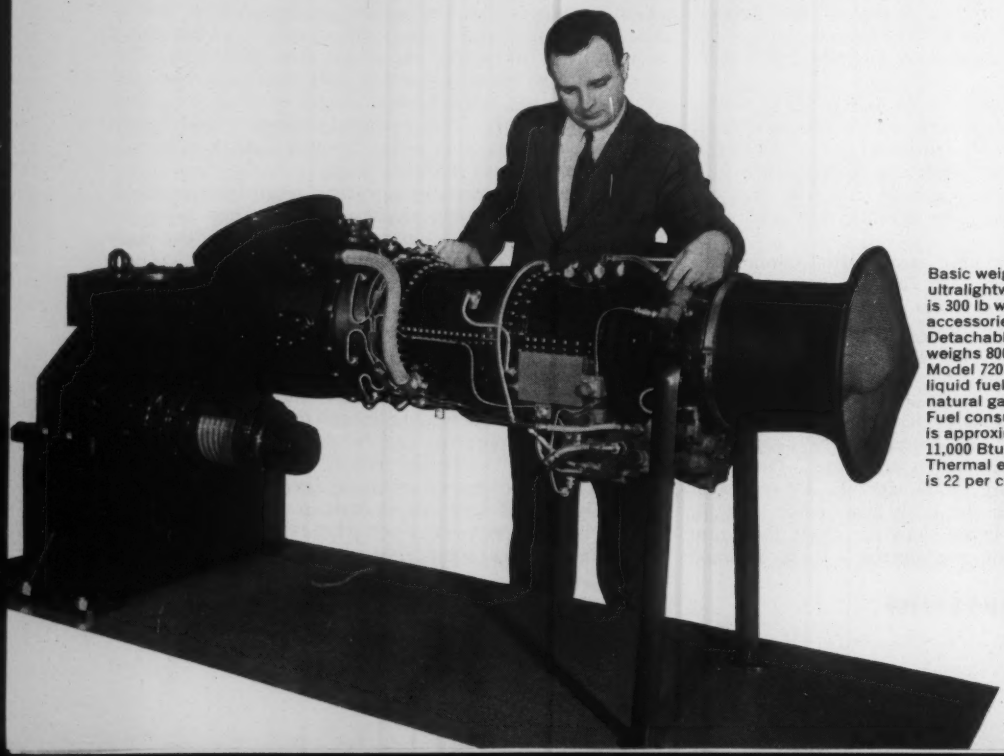
This gas turbine is also being installed as prime propulsion for an amphibious tracked landing craft being built by Jered Industries for the Navy's Bureau of Ships. Model 720 is now propelling a 24-ft experimental hydrofoil boat built by Dynamic Development, Inc., which has achieved speeds of 60 knots.[1] It will also serve as the maneuvering or "docking" engine in the 80-ton hydrofoil powered by the Model 240. The Model 720/722 weighs 300 lb in its basic form, while typical engine packages with reduction gearing weigh about 1200 lb.

Model 720 operates on kerosene, marine diesel oil, and aircraft gasolines, while the 722, similar in most respects to its sister power plant, burns natural gas.

To produce electric power for auxiliary or emergency purposes and in remote, inaccessible areas, the Model 240 gas turbine is also being offered in a complete generating package mounted on a 48-ft-long semitrailer for optimum mobility.

With a total weight of 95,000 lb including gas turbine, generator, and associated switchgear and electrical distribution apparatus, the trailer unit cannot only be

[1] A paper entitled "Gas-Turbine Propulsion for Hydrofoil Boats," by Kenneth A. Austin, will appear in a forthcoming issue of MECHANICAL ENGINNERING.



Basic weight of the ultralightweight gas turbines is 300 lb with running accessories. Detachable reduction gearing weighs 800 to 900 lb. Model 720 operates on liquid fuels, the 722 on natural gas. Fuel consumption of both is approximately 11,000 Btu per hp per hr. Thermal efficiency is 22 per cent.

The 920-shp Model 720 is propelling a 24-ft experimental hydrofoil and will serve as aft maneuvering or "docking" engine in this 80-ton hydrofoil powered by the 20,000-shp Model 240

moved along highways but also airlifted in current large military cargo aircraft.

Mobile Power Plant Specifications

Power capability

At 60 cps

Design output, kva	7500
Power factor design, pf	0.8
Output voltage, volts	13800
Prime-mover operating conditions	
Plant thermal efficiency, per cent	22.4
Fuel consumption, lb per hp per hr	0.588

At 50 cps

Design output, kva	6250
Power factor design, pf	0.8
Output voltage, volts	11500
Prime-mover operating conditions	
Plant thermal efficency, per cent	21.5
Fuel consumption, lb per hp per hr	0.608

A 75-kva step-down transformer provides three-phase, 208-volt, and single-phase, 120-volt housekeeping power.

A 5-kw auxiliary generator provides single-phase, 115-volt alternating current during main-power-unit shutdown.

Model 720 Specifications, Sea Level, 60 F

Maximum continuous shp	900
Fuel consumption at maximum continuous power Model 720/722, Btu per hp per hr	11500
Thermal efficiency, per cent	22
Engine weight with running accessories, lb	300[a]
Over-all length with gearing, in.	85
Height with gearing, in.	40
Pressure ratio	8.3:1
Compressor airflow, lb per sec	12.4
Power turbine speed, rpm	19500
Output shaft speed, rpm	19500
Reduction-gear output shaft speed, rpm	2800
Turbine-inlet temperature, deg F	1530

[a] Does not include reduction gear which weighs 800 to 900 lb depending on gearing selected. Total power package weighs about 1200 lb.

Gas-Turbine Ore Truck

A REGENERATIVE-GAS-TURBINE engine has been installed in a truck and subjected to the rugged requirements of ore hauling at the open-pit mine of the International Nickel Company of Canada, Ltd., in the Sudbury District of Ontario.

The GMT-305 Whirlfire turbine engine was manufactured by the Allison Division of General Motors Corporation, Indianapolis, Ind. The 225-hp engine, which is the culmination of years of research and development by the General Motors Research Laboratory, is a multifuel engine with more than double the power of a comparable piston engine per unit volume and approximately 70 per cent more power per pound.

International Nickel research helped to develop the heat-resistant nickel alloys which made possible the use of gas-turbine engines in turboprop and turbojet aircraft.

In many ways, the open-pit mine should prove to be an ideal testing ground for this new engine. Although the crushing plant is located only about 1000 ft from where the shovels are working on the pit floor, the turbine-powered truck will have to travel almost two grueling miles over a road winding upward at an 8 per cent grade around the inside of the pit walls before reaching the surface with its load of 32 tons of ore. The gas-turbine engine is built for this kind of performance. It requires fewer speed changes in the transmission, and its broad horsepower curve allows operation over a wide output-speed range with minimum loss of power.

The gas-turbine engine is also ideally suited for the climate in the Sudbury District, where the mercury often dips well below zero. The GMT-305 engine has been started, after extended cold soaking, at −45 F in about 30 sec. In fact, it can be started even at temperatures as low as −65 F.

Negligible oil consumption, multifuel capabilities, and optimum fuel economy at full power make the GMT-305 Whirlfire extremely economical to operate.

Approximately 30 lb of nickel is used in the alloys in this prototype engine. The highest percentage of nickel-containing materials is utilized in the hot-end components such as the turbine blades, turbine wheels, combustion chambers, and nozzle vanes. The drum-type regenerator, which operates at a lower temperature, also relies heavily on nickel-containing alloys.

In the gasifier-turbine and power-turbine rotor assemblies nickel-containing alloys are used in the blades (GMR-235, a heat-resistant 63Ni-15Cr-6Mo cast alloy); wheels (16-25-6 alloy, a moderately heat-resistant nickel-chromium alloy forging with properties of high ductility and yield strength); shafts (AISI 4340, a nickel, chromium, molybdenum, high-strength heat-treated steel) and turbine bolts (Inconel X age-hardenable nickel-chromium alloy with high strength and low creep rate at temperatures up to 1500 F).

Castings of SAE 60347, a heat-resistant iron-base 10.5Ni-18Cr alloy, are used in the transition liner support, turbine casing, engine bulkhead and extensions, and the nozzle support and casing.

Hastelloy X nickel-base sheet alloy, which retains high strength at high temperatures, is employed in the combustion chambers and transition liners. The crossover tube is made from wrought SAE 30347, a heat-resistant iron-base alloy of 11 per cent nickel.

Improved 5-Kw Generator

AN IMPROVED 5-kw, 60-cps generator set, powered by an air-cooled gasoline engine that is smaller, more compact, and 40 per cent lighter than a liquid-cooled engine, has been developed by the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., with the co-operation of private industry.

The new set is designed for operation at rated load in tropical heat or Arctic cold, during blowing snow or pouring rain, and at any elevation.

By means of simple reconnecting devices, the 5-kw set is capable of producing four kinds of electric service: 120-volt, 1-phase, 2-wire; 120/240-volt, 1-phase, 3-wire; 120-volt, 3-phase, 3-wire; or 120/208-volt, 3-phase, 4-wire.

The power produced is of the quality needed for operation of communication and surveillance systems and missile systems, or for lighting, water-supply, or tool requirements.

The new generator is expected to be ready for field service sometime in 1960.

GMR Stirling Thermal Engine

One more type of engine is entering the field of possible contenders with diesel and internal-combustion engines. It is the GMR Stirling Thermal Engine, being developed co-operatively for American commercial and military applications by N. V. Philips Gloeilampenfabrieken of Eindhoven, The Netherlands, and General Motors Corporation. The first two engines, built by Philips, were tested at General Motors Research Laboratories in September, 1959.

Details of another engine in the design stages are given in a paper by Gregory Flynn, Jr., Worth H. Percival, Assoc. Mem. ASME, and F. Earl Heffner, Assoc. Mem. ASME, presented at the recent Annual Meeting of the Society of Automotive Engineers.

Basic Construction. Three thermodynamic loops, two pistons in a single cylinder, and a rhombic drive mechanism constitute the principal parts of the engine which operates on the century-old Stirling cycle, but is otherwise new.

A closed-loop gas system provides the expansion to drive the power piston. Heat is introduced via a separate surrounding combustion and heat-exchanging open loop. The third loop contains cooling water which absorbs heat from the closed-loop gas system. By a thermal interchange between these loops and movement of the working gas to alternate hot and cold portions of the closed gas loop, the expansion drives rhombic gears through a power piston. The operating cycle is timed from the same gears by driving the displacer piston with a concentric connecting rod that passes through the hollow power-piston rod.

The displacer piston is a thin steel shell which fits loosely in the cylinder and requires no rings. It serves to control the location of the gas within the total volume established by the power piston, which effects compression or expansion and moves independently. When the displacer piston is at the top of the cylinder, most of the gas is in the cold spaces. Downward movement of the displacer piston forces the gas through the heat-exchanger circuit upward through the cooler, regenerator, and heater into the hot spaces. The net effect of moving the displacer piston down is to heat the gas. Reverse motion of the displacer piston upward from the bottom of its travel effects a cooling of the gas.

Thus the primary function of the power piston is to compress and expand the working fluid, and the primary function of the displacer piston is to heat and cool the working fluid. There is also gas in a buffer space below the power piston which is not involved in the thermodynamic cycle but merely serves as a "spring" to counter the forces of the working fluid.

Heat Source. The Stirling Thermal Engine will operate from any heat source of sufficiently high temperature. Fuel is mixed with air which has had some heat imparted in passing through the preheater, and the mixture is ignited in the combustion chamber. The combustion products pass through the closely spaced stainless-steel tubes brazed into the cylinder head which form the engine heater. There they exchange the major portion of their heat with the working gas contained in the closed loop, then pass through the preheater where some of the remaining heat is salvaged for preheating the incoming air before the cooled exhaust is discharged to atmosphere.

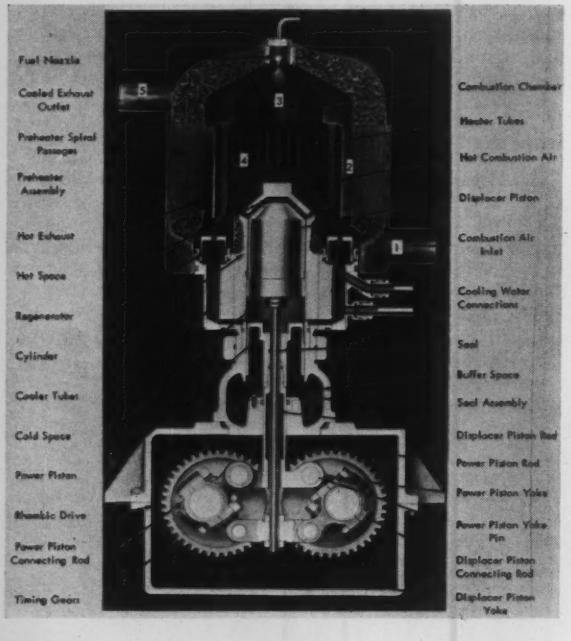
In the closed loop, the working fluid after being heated in the tubes of the engine heater passes downward through the regenerator where some of the heat is stored for recovery by the working fluid on its return trip after it has passed through the cooler and the cold spaces of the cylinder.

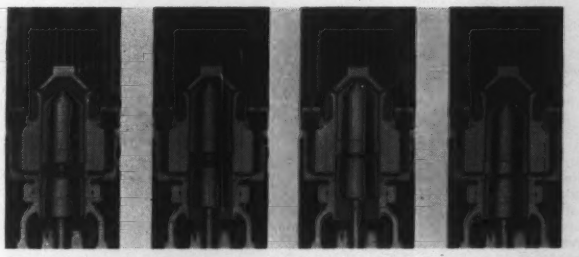
Rhombic Drive. The rhombic drive consists of two similar, contrarotating crankshafts with one crank on each crankshaft. These shafts are timed together by the pair of helical timing gears. The power piston is connected to the cranks by the power-piston rod, the power-piston yoke, and the power-piston connecting rods. A similar series of parts connects the displacer piston to the crankshafts through a lower yoke and connecting-rod assembly. There are actually two power-piston connecting rods on each crank, and they are spaced by the yoke to serve as a single, split connecting rod. The lower displacer-piston connecting rod fits on the crank between the two power-piston connecting rods.

Some of the advantages of the engine may be seen from the Table. Other major advantages are quietness of operation and cleanness of exhaust. When Stirling engines are operating, the most evident noise is that of the timing gears on the crankshafts. The larger Stirling engine sounds much like an electric motor when operating under load, while the smaller engine is somewhat noisier due to the higher operating speed.

The Stirling external-combustion engine can operate from a wide range of fuels from another type of heat source. The laboratory Stirling engines produce cool, colorless, odorless, carbon-monoxide-free exhaust when operating on No. 1 diesel fuel.

The Stirling thermal engine is an external-combustion engine. Fue and combustion products never enter the working spaces of the engine. The essential elements of this external circuit are the preheater which heats the incoming combustion air with heat from the departing exhaust products, the combustion chamber where fuel is burned, and the engine heater tubes through which energy is transferred from the combustion products to the working gas in the engine cylinder. In the attached closed loop, the net effect of moving the displacer piston down is to heat the gas. Moving it up cools the gas. Primary function of the power piston is to compress and expand the fluid. The two pistons are timed together but move independently.





The piston-position sequence for the Stirling engine. Both pistons are driven from the same rhombic drive. Shaft for one passes through the other.

Comparison With Other Large-Engine Types

Engine	Stirling	6-Cyl diesel	Auto V-8
Ideal cycle	Stirling	2-Stroke diesel	Otto
Fuel	Diesel No. 1	Diesel No. 1	Gasoline
Fuel heating value, Btu per lb	18,200	18,200	18,900
Bore, in.	3.47	4.25	4.06
Stroke, in.	2.37	5.00	3.56
Displacement per cylinder, cu in.	20.08	71	46.25
Total engine weight, lb	450	2190	678
Maximum-economy data			
Minimum bsfc, lb per bhp-hr	0.358	0.40	0.415
Brake horsepower	30	181	199
Speed, rpm	1500	1700	3000
Max. thermal efficiency, per cent	39.0	34.8	32.4
Full-load data			
Total horsepower	40	210	242
Hp per cylinder	40	35	30.2
Speed, rpm	2500	2100	4600
Bsfc, lb per bhp-hr	0.418	0.41	0.468
Thermal efficiency, per cent.	33.3	34.0	28.7
Bmep, psi	317	93	113
Specific weight, lb per hp	11	10.4	2.80
Specific output, hp per cu in.	2.00	0.49	0.65

Disadvantages. Some of the disadvantages of the Stirling engine become apparent when the complete power plant and its accessories are considered. First, most of the heat rejected from the Stirling cycle is rejected to the cooler with little leaving to the atmosphere through the exhaust gases. Thus it is estimated that the Stirling engine would require a radiator about 2.5 times as large as that of an internal-combustion engine of the same shaft horsepower. However, the high efficiency of the Stirling engine tends to minimize this effect.

The engine's external-combustion system also requires a blower to force the air through the preheater and the combustion chamber. This constitutes a parasitic power loss and can be a source of noise.

Cost and Future Place. Although the Stirling engine is far from the production stage, it will cost appreciably more than other modern engines because of the complexity of the heat-exchanger construction required. This must be hydrogen-tight. The complete balance and careful piston timing achieved by the rhombic drive are obtained at the expense of considerably more mechanical complexity than that of a simple-crank mechanism.

The authors state in regard to the place that the Stirling engine will probably take among future prime movers: (*a*) For large-engine installations, the weight and efficiency will be at least as good as those of high-economy diesels and will be used where quiet operation and odorless exhaust warrant additional cost; (*b*) in small-engine installations of 10 hp or less it will be used where significant efficiency, low-noise, and clean-exhaust advantages would compensate for extra weight and cost.

Combined-Cycle Power Generation

AN ELECTRIC-GENERATING cycle combining a steam turbine and a gas turbine will be installed at the Muskingum River Plant of the Ohio Power Company at Beverly, Ohio. A 5000-kw prototype gas turbine, driven by coal gas, will be built adjacent to one of the plant's existing 215,000-kw steam turbines.

The gas-turbine unit will not only generate an additional 5000 kw of electric power, but it will supply combustible by-products to the steam boiler. Coal for the gas turbine, broken down by high temperature in a carbonizer, will yield both gas and char. The gas will be burned in the gas turbine. The hot exhaust from the gas turbine will join the other in a cyclone-type burner firing into the pulverized-coal-fired boiler. The char will burn and supply a portion of the steam generated for the steam turbine, reducing the amount of coal required.

It is expected that the gas turbine will be completed and in operation by the Spring of 1961.

Objective of the combination cycle is added efficiency of generation, and, in later full-scale application of this cycle, an improvement of 4 per cent in over-all efficiency is expected to be achieved.

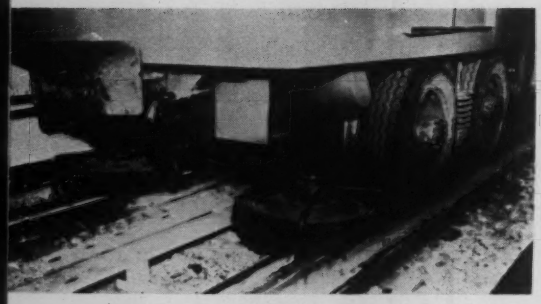
Previously, the use of gas turbines in power production has been limited and they have burned only natural gas and distillate and bunker-C oils. The Muskingum River installation will be the first to use coal gas.

Because the installation is experimental in some respects, only a portion of the gas-turbine capacity which could be used in combination with a steam turbine as large as 215,000 kw will be employed. It is anticipated, however, that successful operation of the unit will lead to gas-turbine steam-turbine combinations in which the gas-turbine capacity will be a much greater part of the total and in which much larger gas turbines than any that have been designed and built to date might be utilized.

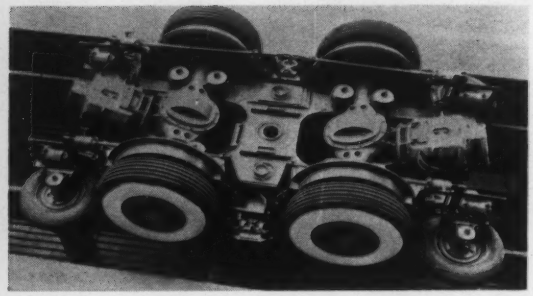
A joint announcement by Philip Sporn, Hon. Mem. ASME, president of American Electric Power Company and of Ohio Power, its subsidiary operating company, and by William S. Ginn, Mem. ASME, vice-president and general manager, Turbine Division, General Electric Company, stressed that this project is but another step in a long series of co-operative developments by the two organizations going back more than 40 years and having as its aim the advancement of the technology and the economics of large-scale generation of power. In the course of this series, a great deal of preliminary work had been carried out in the development of larger generating units, higher speeds, higher steam temperatures, reheat and double reheat of steam, and, most recently, ultrahigh steam pressures.

In the joint project, General Electric will supply the gas turbine and its control devices, the carbonizer, and the related coal and char-feeding devices. Design and construction of the installation will be carried out by the American Electric Power Service Corporation, another AEP subsidiary.

The new gas turbine will be housed in an annex to be constructed at one end of the power plant. It will be coupled to the plant's Unit 1, which was placed in operation in 1953. This unit, plus three similar units, will give the plant a total generating capacity of 880,000 kw, making it the largest power station on the seven-stage American Electric Power System.



London uses horizontal guide wheels which press against low side walls or walings



Inner steel wheels assume the weight when negotiating switches or crossovers. Weight returns to the tires after the crossing is over.

Rubber-Tired Subways

Two European subway systems are experimenting with rubber-tired coaches—the Paris Métro and the Milan underground. As described in an article by A. K. Smee in *Rubber Developments*, published in London, and in additional information furnished by the Natural Rubber Bureau, Washington, D. C., the two systems differ in construction.

Upon the urging of the Michelin Tire Company, the Métro agreed to a test in 1950, and a prototype rail car ran over 37,500 miles of test service between 1952 and 1954 on a shuttle run between Pre-Saint-Gervais and Porte des Lilas. Natural-rubber tires, bolstered by four metal-gauze layers, indicated a life expectancy of about 125,000 miles before retreading, with a possibility of four retreads.

The tires run on strips of azobe, a thick-grained wood from equatorial Africa, almost a foot in width and embedded in prestressed concrete. In the event of a flat tire, a small wheel, normally in suspension, comes down on a steel rail set in the cement beneath and inside the wooden rail, and supports the weight of the car at that point.

Rubber-tired wheels at right angles to the load-bearing wheels press against the inside faces of low side walls or walings to guide the car truck along the track and around curves. The inner steel wheels which provide support in case of a flat also assume the weight of the car when negotiating switches or crossovers, returning the weight to the rubber tires after crossing.

In addition to quieter and smoother operation—some passengers said it was now possible to sleep standing up—acceleration and deceleration were more rapid and braking was more positive. The elimination of hard jolts and strains should permit lighter and cheaper bodies, motors, controls, bolts, and other parts. The hardwood rolling surface is cheaper than conventional track and permits steeper grades. It was also found that the headway between trains could be reduced from 1:45 min to 1:30 min, increasing the carrying capacity of the equipment considerably.

There are now 17 four-car rubber-tired trains in use on the four-mile run between Chatelet and Lilas and it is planned to convert the entire Métro system to rubber-tired operation. Each train has a capacity of 650 passengers, and the reduced headway will make it unnecessary to lengthen station platforms—longer trains were the only previous means of upping rush-hour capacity.

Ing. Raffaello Maestrelli, founder and director of the Società per la Strada Guidata, originated the system to be used on the Milan subway which is now nearing completion. Guidance is accomplished without extra steel

Russian Electric Production

Russia is far behind the United States in the production of electric power and the gap will widen by 1965, according to Charles E. Eble, president of Consolidated Edison Company, N. Y., speaking at the recent Winter General Meeting of the American Institute of Electrical Engineers.

"The latest Russian Seven-Year Plan calls for installation of some 60 million kw of capacity between 1959 and 1965, bringing Russia's total then to about 113 million kw."

According to reliable forecasts, the U. S. will have 250 million kw by 1965. Thus the gap between the United States and Russia power capacities, which was 107 million kw in 1958, will have increased to about 137 million by 1965.

Mr. Eble was one of the group of utility executives who toured Siberian electric installations last summer under the aegis of the State Department.

He stated that the Russians have joined us in the conclusion that hydro power is more economical than thermal power "only under the most favorable conditions." Russia has more than three times the potential hydro capacity of the United States, but four fifths of it is in Siberia, far from centers of civilization, he observed.

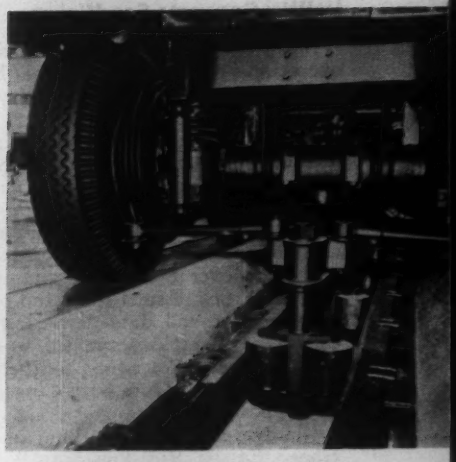
"In the generation of thermal power the Russians appear to lag well behind the United States," Mr. Eble said. "Both in the use of large-scale generating units and in the use of extremely high steam temperatures, the Russians are behind the United States and their plants cannot help but suffer relative inefficiency."

Russia now has one 5000-kw and one 100,000-kw atomic generating plant in operation, with three under construction. "By comparison, we have three plants in operation, 14 scheduled for completion between now and the end of 1963, and several more are planned," he said.

In the use of electricity, Russia concentrates on industry which uses 80 per cent of the total produced, leaving "a mere 20 per cent for residential, farm, and all other uses." The average Russian home used 400 kwhr per yr, in contrast to our 3400. Mr. Eble said that he had heard of no Russian plans to alter the proportion of the output assigned to residential use.

"Looking back over our trip," he said, "I think we can be comforted by the substantial qualitative and quanti-

Milan's subway, now near completion, uses both hydrogen-filled tubeless and trolley-bus tires with the guide mechanism operating in a center trench



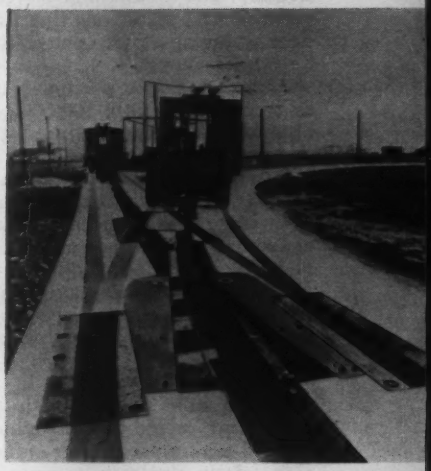
Rollers bear against vertical rubber-faced guide rails mounted in a shallow trench between the tracks. The steering layout is similar to that of a truck or car except that the guide wheels replace the conventional steering wheel of cars

wheels by the substitution of rollers which bear against vertical rubber-faced guide rails mounted in a shallow trench between the tracks. The coaches operate on normal heavy-duty wheels and tires bearing on a narrow track made of concrete, asphalt, or similar material.

The guide mechanism consists of units of four steel rollers mounted vertically tandem fashion in pairs attached by a vertical pin to a framework connected by a central pivot to the underside of the axle. Drag links, connected to this framework, actuate steering arms on each stub axle. In effect, the steering layout is similar to that of a car or truck except that the guide wheels replace the conventional steering wheel.

As each pair of wheels has its own guide mechanism, no matter how long the train of coaches may be, each wheel will follow exactly the path of the wheel ahead, and the steering mechanism will function equally well in either direction. Very sharp turns can be negotiated if desirable. The vertical pins are sufficiently strong to withstand the entire centrifugal force set up by a fully loaded coach traversing a curve with a radius of 120 meters at 80 kilometers per hr. It is impossible for a coach to leave the track unless there is a failure of one of these pins or an anchorage.

The tires, developed by Pirelli, are of two types—one hydrogen-filled and tubeless, the other similar to those used on Milan trolleybuses.



Gaps wide enough for the passage of the vertical pins of the guide mechanism must be left in the wheel track at switches. These are negotiated by the rubber-tired wheels with only a slight jolt that is hardly noticeable.

tive lead we hold in this vital industrial area. On the other hand, I saw nothing that would encourage complacency on our part."

Glass-Reinforced Plastic Pipe

AN IMPROVED, lower-cost plastic pipe announced by Esso Research and Engineering Company may help the oil industry reduce its annual multimillion-dollar corrosion costs.

Based on an improved pipe lining and a company-developed resin which costs less than resins now being used for this purpose, the new glass-reinforced pipe is easy to handle due to its light weight, has the best temperature resistance of any glass-reinforced plastic pipe, and, according to laboratory data, is expected to have the longest useful life.

Results of field studies show that the pipe can be installed on flat terrain faster by two men than ordinary pipe by a typical five-man crew. The pipe can withstand temperatures ranging from −40 to +300 F. The resin is extremely resistant to water, a major enemy of underground pipes. The total cost, including installation and long-term maintenance, is expected to make the pipe competitive with steel.

The new pipe is an outgrowth of a program of research started by the company early in 1957 and in which more than 18,000 ft of different types of plastic pipe are being field-tested by affiliates.

The lining, made by combining a synthetic rubber and a plastic (butadiene-acrylonitrile rubber and polyvinyl chloride), prevents internal abrasion and erosion of the glass reinforcing material. Resistant to oil and chemicals, the lining is vulcanized at the same temperature at which the pipe is cured. A chemical reaction between the resin and the lining results in strong adhesion.

A new mechanical coupling device, developed in cooperation with the Spiral-Glas Pipe Company, Old Bridge, N. J., is a related technical development to permit fast and effective joining of pipe sections.

The glass-reinforced plastic is corrosion-resistant, has better throughput characteristics, is light in weight, has a high strength-to-weight ratio and low thermal and electrical conductivity.

The resin, an Esso Research development, is being marketed by the Enjay Company as "Buton."

Utility Converts Sea Water

A SEA-WATER conversion plant has just been placed in operation by Southern California Edison Company at its steam-electric plant on Mandalay Beach near Oxnard, Calif.

The 100,000-gpd unit was designed, engineered, and manufactured by Cleaver-Brooks Special Products, Waukesha, Wis. Cost of the unit and installation was reported in excess of $250,000.

The 26-stage flash evaporator's main component measures over 70 ft long and weighs 40 tons. The entire unit used over 8 miles of aluminum-brass tubing and nearly 50 tons of steel sheet and plate.

Experience and data derived from experiments with this pilot plant are expected to provide technical and cost information leading to the eventual construction of saline-water plants with capacities of 5 to 10 million gpd of potable water.

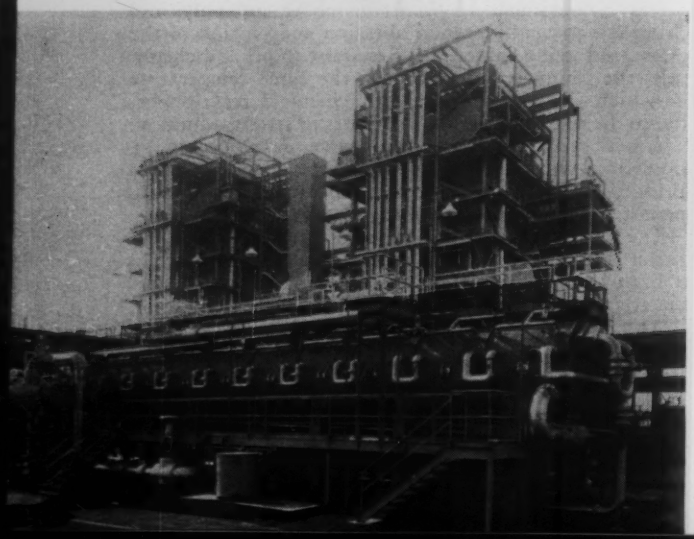
"However, we are talking about the future," cautioned Edison Vice-President W. L. Chadwick, Mem. ASME, "and it should be emphasized that this is a pilot experimental plant, one that cannot be expected to produce water at a cost competitive with present Southern California sources."

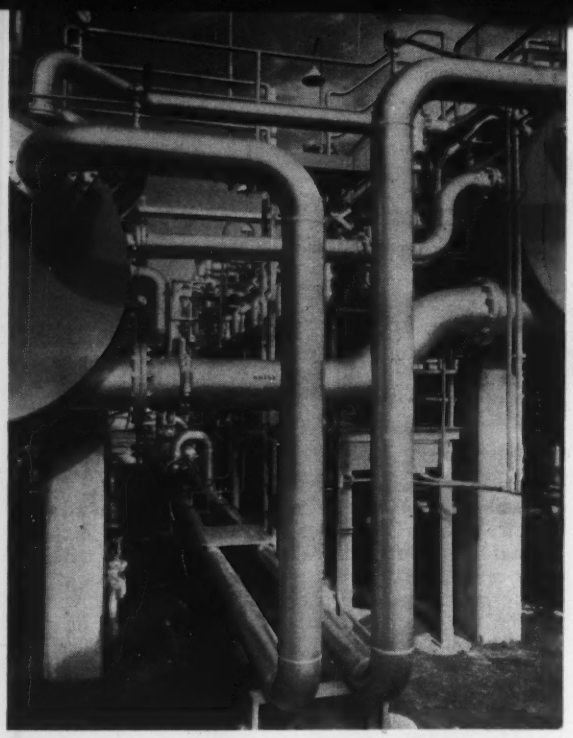
Although Edison's saline-water converter will have a daily output of only 100,000 gal, it has aroused interest because of the opportunities it affords for use of waste and lower-grade heat.

Relatively inexpensive steam which has nearly passed through the station's turbine is extracted for use in the multistage flash-evaporator plant. This type of evaporator has several advantages, including substantially scale-free operation, simplicity of operation, use of relatively low-level heat sources, and favorable initial cost. An unusual amount of operating flexibility will permit it to be used a number of different ways for experimental purposes.

According to Gordon F. Leitner, Mem. ASME, Cleaver-Brooks Special Products vice-president, the development "could be the beginning of the breakthrough toward making sea water suitable for human consumption. It is also significant in that it represents a step sponsored entirely by private industry to bring economic conversion of sea water in the United States closer to reality."

California Edison's Mandalay Steam Station combines sea-water conversion with steam-electric generation. Relatively inexpensive steam which has nearly passed through the station's turbine is extracted for use in the evaporator. The 26-stage flash evaporator's main component is over 70 ft long and weighs 40 tons. Operation is scale-free and initial cost of the installation is comparatively low.





The entire flash-evaporator unit uses over 8 miles of aluminum-brass tubing—nearly 50 tons of steel sheet and plate. Output is 100,000 gpd. The $250,000 unit has an unusual amount of operating flexibility to permit it to be used in different ways for experimental purposes.

New Temperature-Sensing System

A NEW infrared system sensitive enough to see moving objects near room temperature, solely by means of the invisible heat rays which they emit, has been developed by Westinghouse Research Laboratories in Pittsburgh, Pa, and Wright Air Development Center.

Disclosed at the Winter Meeting of the American Institute of Electrical Engineers, it is known as a photothermionic image converter. The all-electronic device changes the infrared radiation emitted by an object into a visible picture on a television screen, and is sensitive enough to detect moving objects near room temperature when they exhibit temperature differences of approximately 20 F—just about the spread between human-body and average-living-room temperatures.

The device operates on far-infrared (radiation of relatively long wavelength emitted by comparatively cool objects) in contrast to hotter near-infrared radiation.

The key component is a unique infrared-sensitive detector, or retina—a three-layer sandwich only a few millionths of an inch thick. The center layer is aluminum oxide, the front surface is nickel, and the back surface is cesium bismuth. The photoemitter (back layer) releases electrons under the stimulus of light at a rate which varies two or three per cent for every degree of temperature change.

To increase the over-all sensitivity and performance of the detector, it is cooled to about −180 F.

In use, the infrared radiation forms a temperature pattern on the heat-absorbing layer of the retina, which transfers through the thin support layer to the photo-emitting surface, where it can be perceived simply by scanning a spot of light across the surface. As the light spot scans the photo-emitting surface, many or few electrons flow from the surface in exact conformity to the heat pattern on it.

Counters on the sWitch-Carts are set for the number of the loading dock desired. When the proper track is reached, the rod which connects the truck to the dragline is retracted and a guide rod drops into the spur-track guide slot to the left, diverting the cart off the dragline.

Switching Cart Conveyer

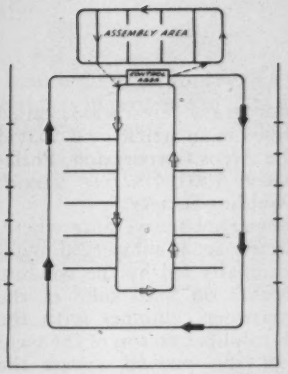
A SIMPLIFIED freight-handling cart conveyer at the new Brooklyn terminal of Spector Freight Systems, Inc., facilitates the receiving and breaking of small-package shipments for reassembly by destination. A sWitch-Cart which has a simple guiding and connecting system, and a dragline operated by two 5-hp electric motors, are the principal devices used. Carts and routing devices are made by SI Handling Systems, Inc., Easton, Pa., the Towveyor draglines by Jervis B. Webb Company, Detroit, Mich.

Carts are manually loaded at the incoming loading docks, with the shipment broken so that each cart contains packages for a single destination. When a cart is fully loaded, it is centered over the slot for a dragline which runs around the outer portion of the warehouse. A connecting bar is dropped and the cart is automatically hauled in a rectangular path until it reaches the control area. Here it is automatically weighed and its tare weight is printed out for comparison with the declaration.

If the truck trailer for the destination represented by the cart is waiting at the outgoing dock, the dispatcher sets a counter on the front of the vehicle representing the number of the loading dock desired. As the cart passes each switching point along the route, a wedge-shaped tripper on the floor reduces the count by one number. When zero is reached, the connecting rod is retracted by tripping a spring catch. At the same time, a guide rod a few inches to the side drops into a spur track.

The spurs have no dragline and the cart waits until it is bumped by a following drag-connected cart. This shunts it off the line and gravity carries it to the end of the spur.

Each of the 32 spurs actually consists of five lines controlled by electric switches. The first line is for front-end freight, the second for center freight, the third for rear freight. The other two are for over, short, and damaged shipments. Carts are color coded for these sorting types. At the same time that the dispatcher sets the dock number on the dial, he pushes a button for the track desired. A synchronized timer opens the switch electrically when the cart arrives.



Freight flows on the outer dragline to the control area where the dispatcher routes carts either directly to the loading docks or to a waiting assembly area

If no truck trailer is waiting for the destination represented by the cart at the time it reaches the control area, an alternate routing is used. The dispatcher sends it to an assembly area where 19 storage lanes are provided. Each has room for 12 carts which are fed into it by gravity and stopped by a pin at the end of the line. When the proper truck arrives at the loading dock, the pin can be withdrawn and the row of carts is fed back onto the dragline. This will convey them to the proper loading dock.

There are 450 switch carts used in the warehouse. Incoming and outgoing docks can be intermixed as the system will deliver a cart from any loading dock to any other. There are more than 1500 ft in the dragline portion of the system and 5000 ft of shunt track. In addition to the 32 doors served by the shunt spurs, there are 20 others at which larger pieces can be handled by fork-lift trucks, although 90 per cent of the terminal's tonnage will be handled by the dragline system.

The $225,000 installation (cost of dragline, carts, and docks) has proved to be very adaptable for variations in load, and 15 other Spector warehouses will be similarly equipped.

Manually loaded carts can be automatically routed to any of 32 loading docks. There are 1500 ft of dragline and 5000 ft of shunt track. Larger pieces will be handled by fork-lift trucks although 90 per cent of the tonnage will be handled by the dragline.

Electroslag Welding

A NEW welding process for heavy fabrication, called electroslag welding, is described in an article by R. David Thomas, Jr., president of the Arcos Corporation, Philadelphia, Pa., in the February, 1960, *Welding Journal*, published by the American Welding Society.

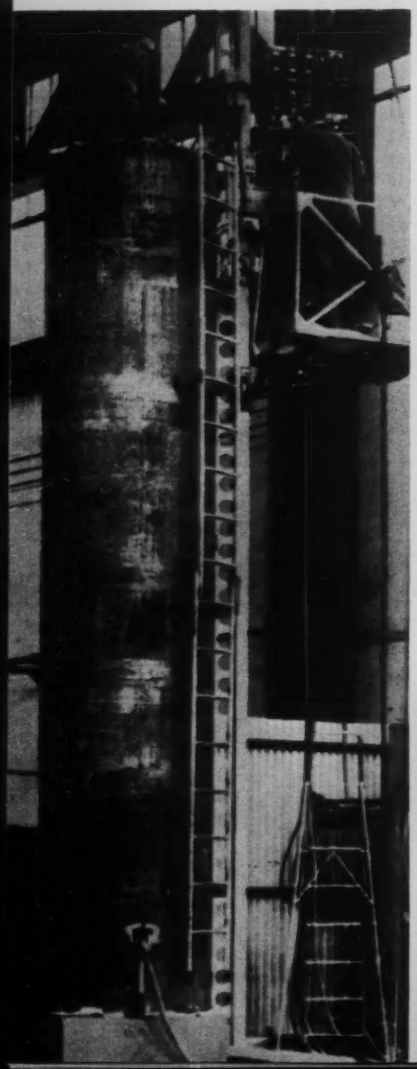
The process differs from submerged-arc welding where, as the name suggests, an electric arc is submerged under powdered granular flux continually fed by the welding machine into V-shaped grooves on both sides of the work. Some of this flux powder combines with the molten metal, part of which solidifies on top of the weld deposit. The remainder of the powder covers the weld and slag, shielding them from atmospheric contamination and retarding the rate of cooling.

In electroslag welding, the heat necessary for fusing the filler metal and both sides of the joint is developed in the slag which accumulates to sufficient depth to cover the molten metal. The molten slag offers a resistance to the flow of electricity, generating sufficient heat to cause fusion of the metal. Since electric power is the product of volts and amperes and electroslag welding permits $1^1/_2$ to 2 times the voltage, it can produce a proportionally greater heat for the same current. To provide a deep slag cover, welding is generally done in a vertical position.

The process has been used in Russia since 1951 with subsequent advances primarily in instrumentation and improved wire. The process did not give as high notch-impact properties as traditional means until Belgian metallurgists introduced composite wires with carefully formulated fluxes and deoxidizers.

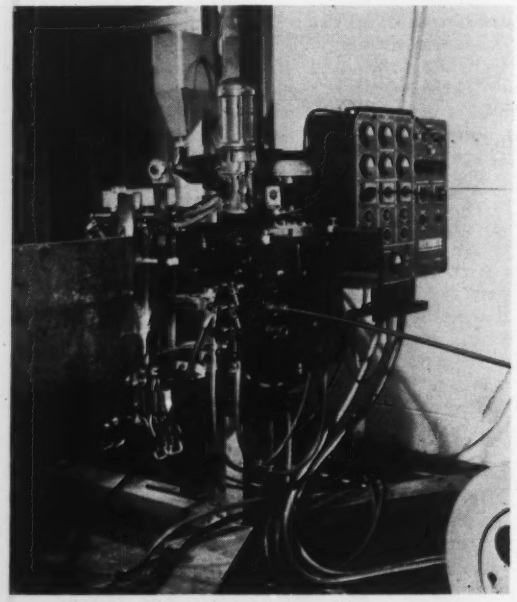
Application. Primary application is for plates at least $1^1/_2$ in. in thickness. For plates up to 4 in. thick, one electrode is used; from 4 to 10 in., two electrodes; and over 10 in., three electrodes. A vertical-drive motor carries the entire machine up a rack attached to the column. Wire is fed through a guide tube by wire-drive rolls mounted on a carriage which can oscillate within preset limits, depending on the thickness of the plate. When multiple electrodes are fed into the molten pool, each wire is connected to its own power transformer. The wire feed contains devices for straightening the wire and cooling it.

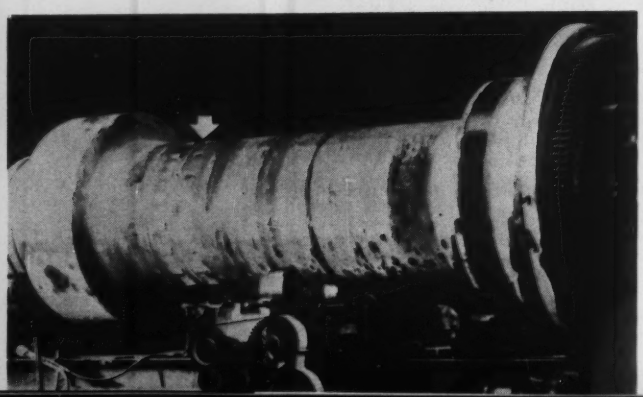
The welding is begun in a U-shaped starting tab tack-welded to the bottom of the joint. Starting is similar to submerged-arc welding, with the transformer set to provide drooping-voltage characteristics during the arc melting of the slag. Granular flux is added until the molten-slag depth is about 2 in. As the amount of molten slag increases, the voltage is raised to the desired level and the leakage of the magnetic flux in the transformer is reduced to give nearly constant-potential opera-



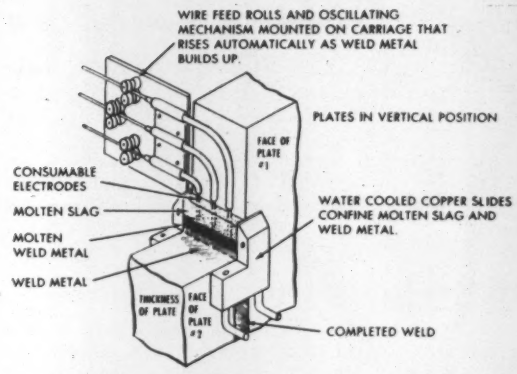
An electroslag weld is made on a longitudinal seam of a propeller stem shaft tube in a shipyard in France. A vertical-drive motor carries the entire machine up a rack. The heat necessary for fusing the filler metal and both sides of the joint is developed in the slag which accumulates to sufficient depth to cover the molten metal. The molten slag offers a resistance to the flow of electricity, generating sufficient heat to cause fusion of the metal.

Electroslag welding equipment with plate in position for welding. The entire machine is carried up a rack attached to the column.





Girth seams present a greater problem for electroslag welding. The carriage of the machine is placed at a fixed level and the sensing-element circuit operates the turning rolls to rotate the cylinder.


WIRE FEED ROLLS AND OSCILLATING MECHANISM MOUNTED ON CARRIAGE THAT RISES AUTOMATICALLY AS WELD METAL BUILDS UP.
PLATES IN VERTICAL POSITION
FACE OF PLATE #1
CONSUMABLE ELECTRODES
MOLTEN SLAG
WATER COOLED COPPER SLIDES CONFINE MOLTEN SLAG AND WELD METAL
MOLTEN WELD METAL
WELD METAL
THICKNESS OF PLATE
FACE OF PLATE #2
COMPLETED WELD

In the electroslag process each wire is connected to its own power transformer. Wire-feed devices straighten and cool the wire.

tion. The current is finally adjusted to the desired level by varying the speed of the wire-feed drive.

The success of electroslag welding lies in proper operation of the automatic rising motion of the carriage. The molds, or shoes, carry a sensing element which automatically signals the rising motion. This water-cooled element, placed in the lower half of the mold, employs a 50-volt relay circuit to energize the motor for raising the carriage whenever the slag film touching that element becomes sufficiently cool to become nonconductive. The carriage continues to rise until the slag again becomes conductive. This action occurs only when the traverse motion is at one of its extremities where it dwells for a few seconds before reversing direction.

The probe in the upper half of the mold is connected to a solenoid which introduces flux from the hopper as needed to maintain a constant slag depth.

Advantages of the Process. For relatively heavy plates, electroslag welding offers economies over submerged-arc welding in two important regards: (*a*) The electroslag process is completely continuous (100 per cent operating time), whereas the duty cycle in the multipass submerged-arc process usually varies from 35 to 65 per cent operating time; the speed of welding will thus be $1^1/_2$ to 3 times faster due to this fact alone; (*b*) the deposition rate is 35 to 45 lb of weld metal per hr per electrode. In very heavy plates, using three electrodes, this means 105 to 135 lb per hr of weld metal deposited.

The amount of filler metal required for thick plates is less. Although the cost of the flux used is high per pound, generally the reduced quantity required offsets this. No advantage over submerged-arc methods is found for thicknesses of less than $1^1/_2$ in. Cost benefits are substantial for thicknesses of 2 in. or over where vertical welding can be employed. The equipment is easily used in the field. The application has been largely confined to ordinary steel although some work with heavy stainless and low-alloy steel has been reported in Europe. Distortion due to weld shrinkage after working is very limited.

Butt welding of heavy seams in long plate is the simplest use and longitudinal welds are easily made in the construction of heavy-walled cylindrical vessels. The girth seams present a greater problem, although they have frequently been made in Europe and one set up for this has been operating in this country since August, 1959.

According to the author, laboratory evaluation of welds is in process and data are being collected to satisfy the requirements of insuring and code-inspection groups.

Properties of Electroslag Welds

	Chemical analysis, per cent					
	C	Mn	Si	S	P	Mo
Manganese-molybdenum	0.08	1.84	0.37	0.016	0.019	0.32
Mild steel	0.13	1.13	0.33	0.024	0.020	0.09

	Mechanical properties				
	Yield strength, psi	Tensile strength, psi	Elongation 2 in., per cent	Reduction in area, per cent	Charpy V-notch at room temp., ft-lb
Manganese-molybdenum	66,000	87,600	19	43	26,28,28
Mild steel	48,700	74,100	28	59	

Automatic Gouging Tool

When heavy steel-plate sections are joined by welding, the mating edges must be prepared to insure complete penetration of the weld deposit. An automatic Arcair Process gouging torch, model Q-3, made by the Arcair Company, Lancaster, Ohio, eliminates prebeveling. The square-edged parts can be fitted together and temporarily joined with a manual weld joint on the exterior of the tank. The vessel is then welded permanently on the inside with the submerged-arc welding process. With the tank mounted on rolls, the automatic gouging torch is then used to remove the temporary outside weld and form a U-groove. Depth of the U-groove is determined by the operator who establishes it with the electrode-feed adjusting knob when sound metal is reached at the root of the interior weld. Operation of the torch is simple. Based on the turning rate of the moving tank, which can be up to 30 ipm, a consumable special carbon-graphite electrode is fed toward the seam at a predetermined rate of speed for the depth of gouge desired.

The only auxiliary requirements are power from almost any good welding machine and a supply of ordinary compressed air. One torch is operated from a 400-amp Lincoln motor-generator-type machine set at about 325, with 90 psi of compressed air supplied from the shop air line. Both the air and the current are piped to the torch through a single concentric cable. Current from the welding machine is positive, the work is negative. When the electrode in the torch is brought close to the work, an electric arc is formed. Heat from the arc melts the metal and simultaneously jets of compressed air from the torch head blow the metal away. The melting and removal of molten metal continue all the time the tool is in use.

The process can be used on any type of metal. Heat input is only about 150 deg per pass—so low that a bare hand can be placed on a gouge shortly after!

A bright clean groove replaces the manually deposited weld metal in the seam. After a light grinding, the groove is then rewelded with automatic equipment to attain 100 per cent penetration. The cost of electrodes used to prepare a $55^1/_4$-in-diam seam is less than one dollar. Time involved is under 5 min.

The automatic torch provides uniformity of depth and straightness of the cut or gouge, because the tool is held in a stationary position.

In this tire-on-tire test of conventional passenger-car tires, the one on the left survived. The one on the right is beginning to leave the rim, its bead yawing wide from the rim. Other tests simulate aircraft landing and take-off conditions.

Tires Tested at 510 Mph

A MULTISTAGE dynamometer system is being used by the Goodyear Tire and Rubber Company to torture test jet-aircraft and racing-car tires at 510 mph, and to determine what makes them fail at ultrahigh speeds.

The $2-million system provides the means to duplicate exactly all of the operational conditions of taxiing, take-off, and landing—even the tremendous impact and the yawing and twisting of tires as a plane touches down on a runway.

Acceleration and deceleration capabilities of the 8600-hp machine exceed any present or anticipated aircraft requirement.

Although the dynamometer system is designed for rigorous "destruction-point" testing of aircraft and racing tires, rather than automobile tires, the knowledge gained from these tests will be used to improve passenger-car tires of the future.

Goodyear passenger-car tires are already track tested at 100 mph for 200 miles, but the day is coming when even these levels will have to be increased.

Several Goodyear passenger-car tires were accelerated to the "breaking point" under simulated-load conditions, but none of them failed at less than 297 mph, and most of them exceeded 300 mph.

Because of the physical dangers involved in running tires at such speeds, the actual testing is viewed on closed-circuit television which monitors all four test carriages.

The machine, built by the Adamson-United Company of Akron, has two separate units and is capable of testing either airplane or automobile tires.

One side of the machine features a unique "tire-on-tire" test facility, where two tires are pressed together, tread to tread, to duplicate actual load conditions, and then driven at surface speeds that can be boosted to more than 500 mph.

The second unit features a huge 10-ft-diam flywheel with a tire carriage on each side. Used primarily for testing airplane tires, it is capable of surface speeds of 320 mph.

Loads of better than 80,000 lb and tire sizes from 16 in. to over 6 ft in diam can be accommodated.

The dynamometer facility is capable of accelerating a tire from zero to 320 mph in less than 20 sec under a 30,000-lb-load condition.

Specially designed racing tires were accelerated to 510 mph. Tires of this type were used on a four-engine racing car which set a new American land-speed record of 332.809 mph. A top speed of 367.3 mph was reached and an attempt will be made to crack the world record of 394.2 mph later this year.

The dynamometer system is powered by two electric motors to reach its peak of 8600 hp and is designed so that both ends of the motor shaft can be utilized as drivers.

One side drives the flywheel, with a test carriage on each end. The opposite end of the shaft actuates a gear which, in turn, drives two pinions on which tires are mounted.

Epoxy-Glass Cargo Carrier

A LARGE reinforced-plastic cargo carrier, built with a spray gun and capable of transporting a 40,000-lb payload by rail, motor, or ship is being evaluated by Union Carbide Plastics Company.

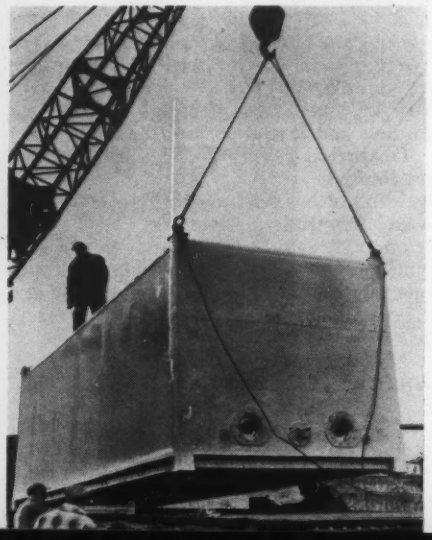
Of epoxy-glass fiber construction, the 28,000-lb container is 24 ft long, 8 ft wide, and 8 ft high and weighs a fourth less than a comparable aluminum carrier. It is characterized by great structural strength and is considerably more rigid than previous carriers. Is exceptionally resistant to abrasion, fatigue, and chemical and salt-water corrosion.

It can be bulk-loaded and then lifted by straddle carrier or ship's crane to a railroad flatcar, flat-bed motor carrier, or shipboard. The cargo carriers can also be stacked five high when they are to be used for ship transport.

Built-up epoxy-glass fiber panels 4 × 8 ft in size were bonded to a steel frame. About half the weight of the steel frame, or about 500 lb, can be saved in future models by eliminating the floor frame and using a monolithic, all-epoxy-glass floor instead of panels bolted to the metal frame. Additional weight savings may be realized also by the use of epoxy-glass corner posts instead of steel posts.

The 4 × 8-ft section consists of a central corrugated sheet of epoxy-glass fiber, together with a flat "skin" of the same material bonded to both sides for added strength, rigidity, and smoothness. The corrugated sheet is 0.08 in. thick and the flat skin 0.1 in. in thickness. The entire panel assembly is about 2 in. thick and weighs 64 lb. The core for the corrugated wall and ceiling sheet is heavy cardboard. The floor panels are built up on an aluminum core, and are designed to carry a floor loading of 250 lb per sq ft.

An epoxy-glass-fiber cargo carrier is loaded onto a flatcar by an automotive crane. Carrier can be tilted 60 deg to discharge contents through spouts.



Construction in progress on a 6050-ft-long, 10-ft-2-in-ID pressure-creosoted Douglas-fir pipeline. The staves will be finished $3^1/_2$ in. thick and $5^1/_2$ in. wide with 72 to the circle and malleable-iron castings between stave ends.

Wooden Pipeline

THE LONG-TIME satisfactory service of a wooden pipeline has led the Upper Peninsula Power Company to select kiln-dried, pressure-creosoted Douglas fir for the construction of a 10-ft 2-in. ID pipe, 6050 ft long, to deliver water from the Victoria Falls Dam to the company's generator station for power development.

The pipe will be supplied by Simpson Engineered Wood Products Company, a division of Simpson Timber Company, Seattle, Wash.

The excellence of the wooden-pipe service was demonstrated when 336 ft of the original untreated-wood pipeline needed replacement in June, 1958, after nearly 30 years of trouble-free operation, and this break was repaired within 23 days. The new creosoted pipe is expected to have a life expectancy of as much as 50 years or longer.

The staves will be finished $3^1/_2$ in. thick and $5^1/_2$ in. wide with 72 to the circle. They will be fabricated with a specially designed malleable-iron casting between stave ends to insure water-tight joints. The continuous-stave pipe will be banded with round steel bands connected with malleable-iron shoes.

The original bands and many concrete cradles and sill foundations were found in salvable condition and re-used in the new pipeline with a saving of many thousands of dollars.

Three quarters of a million board feet of lumber staves will be used in the rebuilding. They will be shipped from the factory knocked down, facilitating delivery to the building site. The job will be erected by local contractors with the technical assistance of a Simpson construction supervisor.

Yankee Reactor Vessel Shipped

THE 165-ton reactor vessel for the Yankee Atomic Electric Company plant at Rowe, Mass., has been shipped from The Babcock & Wilcox Company's Boiler Division works at Barberton, Ohio.

A specially built depressed flatcar three times the length of an ordinary freight car was used to carry the 27-ft-long, 13-ft-across vessel on its 900-mile journey.

To meet design requirements, the 109-in-diam reactor vessel was fabricated in four sections of varying plate thicknesses and internally clad with 0.109-in-thick stainless-steel plate. The top section is $9^5/_8$ in. thick, the middle and lower sections $7^7/_8$ in., and the bottom head $3^7/_8$ in.

Over 20 months were spent on the fabrication of the vessel and more than 6200 quality-control inspections were made to comply with the stringent specifications.

The vessel will be installed in a 125-ft steel containment sphere situated above ground on steel stilts.

The 134,000-kw pressurized-water plant which uses slightly enriched U-235 as fuel, is scheduled to go on line later in 1960.

Another Structural-Damping Material

ANOTHER noise and vibration-damping material (see MECHANICAL ENGINEERING, March, 1960, p. 81) has been announced by Lord Manufacturing Company.

Designated Dyna-damp, the material can control the resonant response of structures exposed to high-frequency vibration and "white" (wide-band) noise experienced in supersonic aircraft which can cause structural fatigue.

The damping medium is a specialized form of Lord's BTR (Board Temperature Range) elastomer which maintains excellent damping and environmental resistance from −65 to +250 F.

Dyna-damp structural sections have a resonant application of only 3 to 5:1, compared with 20 to 100:1 for undamped structures.

In simulated operation-fatigue tests on panels excited by both normal and incident high-intensity sound fields to 170 db, the life of the panels was over 20 times that of a solid aluminum sheet of equal thickness. The damped panels were still undamaged when the tests terminated.

Dyna-damp laminated panels consist of plies of metal plates with BTR elastomer sandwiched between the plates and bonded to them. A typical 20 × 20-in. panel weighs 1.01 lb per sq ft—comparable to the weight of an aluminum sheet of similar size. The panels can be punched, sheared, and formed by the usual stretch-forming techniques employed in the aircraft industry.

Dyna-damp sections have been produced in hat and angle shapes, and many other design configurations are possible. These sections have approximately 60 per cent of the ultimate strength of solid aluminum, allowing integration with load-carrying structures. Attaching them to aluminum panels in various patterns by riveting, spot welding, or suitable adhesive bonding reduces panel response to vibration.

Dyna-damp sections can be applied to structural panels to reduce resonance or be used by themselves as damped load-bearing beams

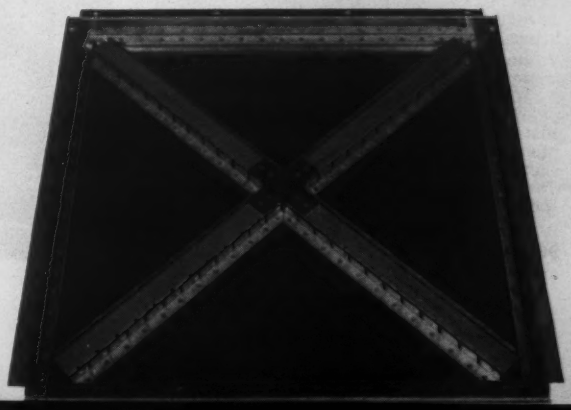


PHOTO BRIEFS

M. BARRANGON

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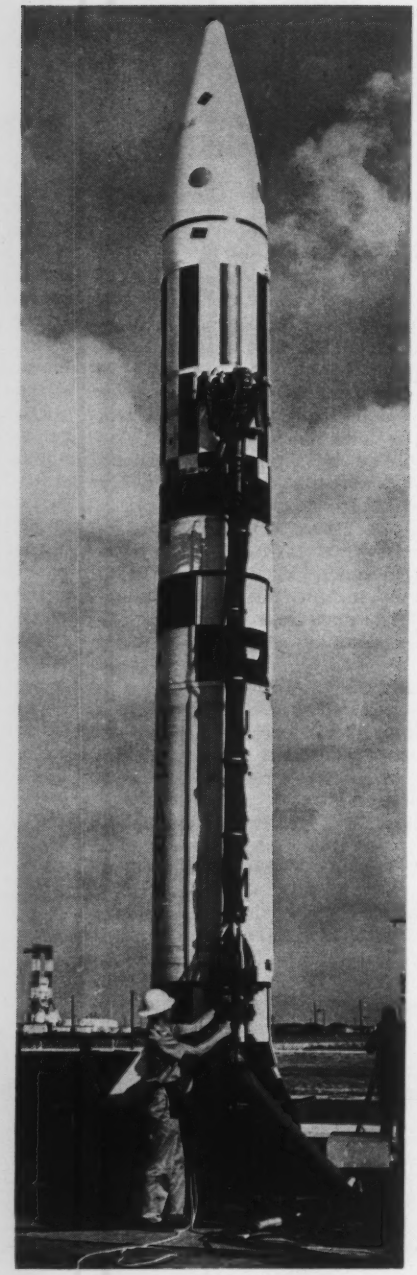


2

1 Tactical Hardware. "Pershing" is the name of this new Army selective, combat-range, artillery missile (SCRAM), now in production at Martin's Orlando, Fla., Division. The missile, under test at Cape Canaveral, is shown in launch position on a transporter-erector-launcher (TEL) which permits it to be transported to a site, and erected and fired within minutes.

2 Main Bearing. This 27-ton steel forging will be the inner spherical seat of the bearing on which the world's largest radio telescope will revolve. U. S. Steel's Homestead Works is machining it to jewel-like precision. The $79-million instrument, now being built on a mountain ridge in West Virginia, will give the Navy the world's longest look into space.

3 Skid Turner. Southworth Machine Company, of Portland, Maine, makes this manipulator which enables one man to turn a skid load of as much as 5000 lb—and in one minute. Originally developed for turning skid loads of paper (printing plants and paper mills), it also serves for liquid products, and drums, barrels, or cans, which must be turned to avoid settling or sedimentation.

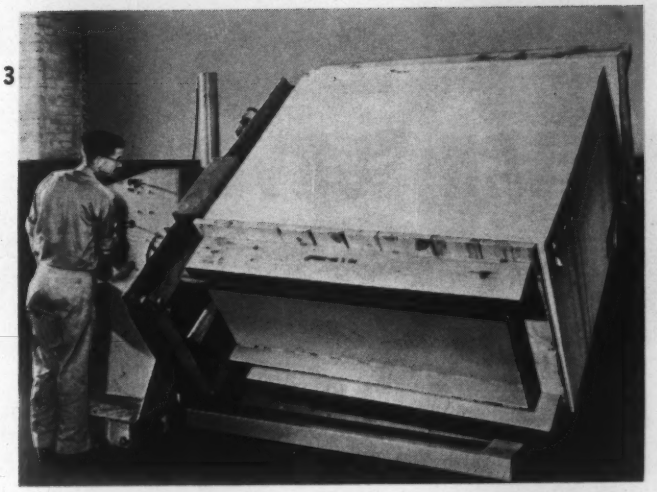
4 Self-Sealing Coupling. For "no-spill" service, this quick-connect quick-disconnect valved coupling was developed for missiles and aircraft by Snap-Tite, Inc., Union City, Pa. Spillage, air inclusion, and pressure drop all had to be within the limits of military requirements. Valves in both the coupler and nipple shut off automatically when the coupling is disconnected.

5 Teeth of Flame. At the Steel-weld Division of the R. C. Mahon Company, Detroit, Mich., gas flames heat the 3-in. walls of a 33-ton, 15-ft-diam steel "bell"—a portion of a blast furnace for Great Lakes Steel Corporation. Purpose: To condition the metal for an armor-like coating to resist wear where iron ore will be dumped in the top of the furnace.

6 Emergency Vacuum. Cut the main line of this vacuum lifter (made by Vac-U-Lift Company of Salem, Ill.), and their new Safti-Pac maintains the vacuum. Whenever the vacuum reaches capacity in the main system, the built-in reserve system (seen at the front of the beam) stores and maintains its own capacity load, ready for emergency. Loads of several tons can be carried by the vacuum lifters.

7 Honeycomb Cutter. The 10-in. carbide cutter is by Kennametal, Inc., Latrobe, Pa. Equally important is the "freeze chuck" developed by Rohr Aircraft Corporation, Chula Vista, Calif. To prevent deformation of the stainless-steel honeycomb during the operation, it is filled with water or soap, and frozen. The carbide tool is used because high-speed tool steel dulled more rapidly in ice.

3



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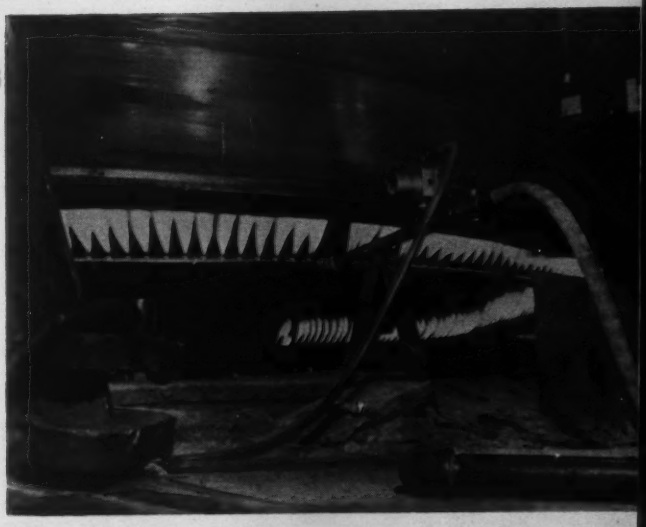

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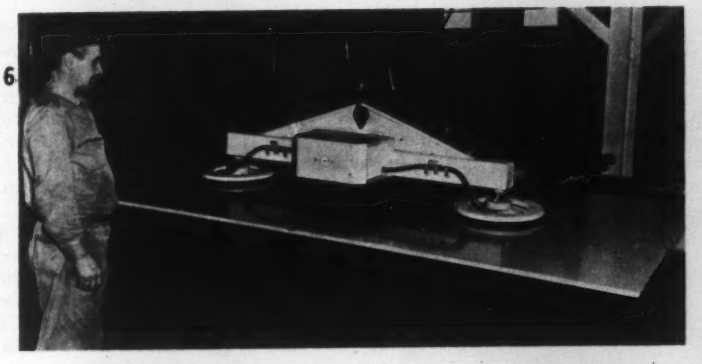
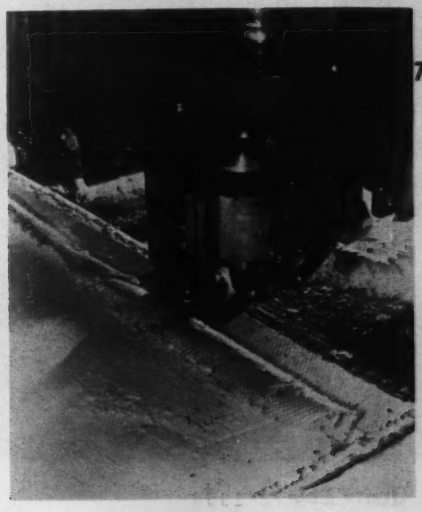




7

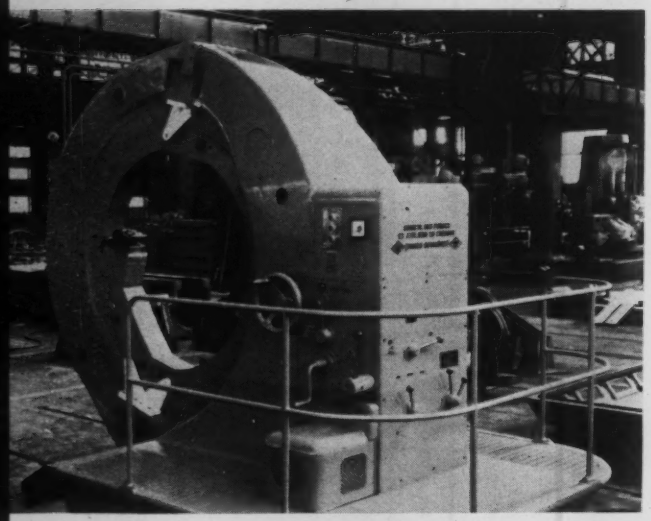
Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European
Correspondent

EUROPEAN SURVEY

Crankpin-Turning Attachment

THE name of Le Creusot in France, like that of Krupp in Germany, used to suggest guns, but their peaceful activities far outweigh their armament production and are very varied. One is the construction of machine tools, an example of which is the crankpin-turning device. It is made in two main forms, one designed for use as an independent tool, which can be taken to the shaft to be turned, and the other as an attachment to a center lathe—the type used in turning shafting.



This French-made crankpin-turning machine, a self-contained tool, is intended for making crankpins for marine Diesel engines

In use, the latter type would be mounted on the lathe tool carrier, the ordinary feed mechanism of the lathe being employed to move the attachment horizontally to produce a cylindrical surface. The independent machine has its own feed arrangement, with a travel sufficient to cover the length of a large crankpin for a marine diesel engine—the kind of work for which it is primarily intended.

The cutting tool is mounted on a ring which is rotated by spur gearing around the crankpin, this ring being in halves for ready removal from one crankpin to the next. The longitudinal and transverse feeds are automatic, but hand adjustment is provided for setting. The device is made and marketed by the Société des Forges et Ateliers du Creusot (Usines Schneider), whose head office is at 15 Rue Pasquier, Paris 8e, France.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

World Power Conference

THE Sectional Meeting of the World Power Conference which is to be held in Madrid, Spain, June 5–June 9, will have the theme, "Methods for Solving Power Shortage Problems."[1] This means that much attention will be given to nuclear power developments. One of the five sections is devoted to the "Establishment of nuclear reactors on an industrial scale," and there is some nuclear topic in three of the remaining four sections.

The program also includes a visit to the Juan Vigón Center of the Nuclear Energy Board, which contains an experimental reactor of the swimming-pool type. The postconference series of study tours, however, will show that Spain is not waiting for the nuclear power station to solve national power problems, but is actively developing the country's considerable water-power resources. There will be six simultaneous tours, radiating from Madrid. All start on June 10, but vary in length, the shortest finishing on June 14 and the longest on June 17.

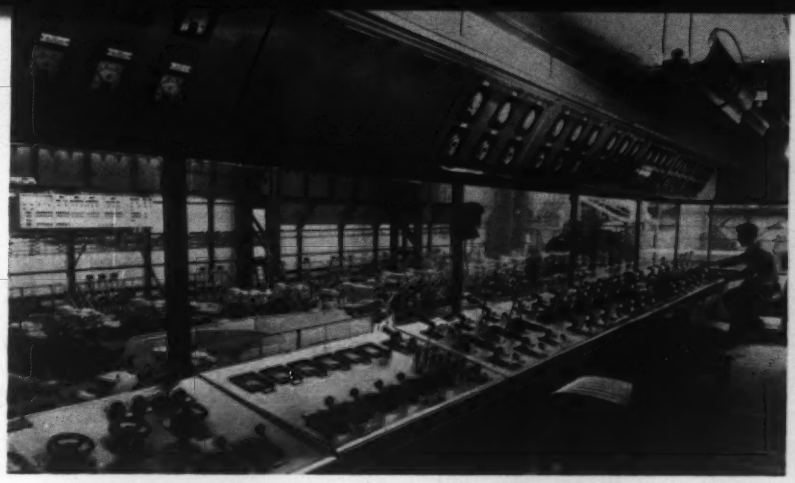
It is 31 years since the previous Sectional Meeting was held in Spain. The headquarters was then at Barcelona and the main topic was the development of water resources. The 1960 meeting should provide a marked contrast with the conditions of 1929.

New Rod Mill

DORMAN, LONG & Co., Middlesbrough, England, have recently brought into service a new rod, bar, and narrow strip mill at their Lackenby works. It is a versatile plant, capable of turning out wire rods of 0.212 in. to 0.40-in. diam, in coils of about 550 to 600 lb; round and square merchant bars from $^3/_8$ in. to $^7/_8$ in., inclusive; angles up to 2 in. by 2 in. by $^3/_8$ in., and flats up to $2^1/_2$ in. by $^1/_2$ in.; and hot rolled strip from 2 in. to 12 in. wide, ranging in thickness from 0.040 in. to 0.300 in.

At the present time the mill has a contract on hand for rods which, in another of the company's works, will be drawn into wire for the new suspension bridge over the River Forth in Scotland. When finished, this will be the longest suspension bridge in Europe. Its main cables will require 7500 tons of galvanized wire, 0.196-

[1] See MECHANICAL ENGINEERING, March, 1960, pp. 118–119.



The main control pulpit of a merchant rod and strip mill at Lackenby works of Dorman, Long & Company, Middlesbrough, England

in. diam and with a tensile strength of 100 to 110 tons psi. Each cable will contain 11,600 wires and will be about 24 in. diam. This is the first time that wire of this quality has been produced in the U.K. for suspension bridge work.

Nuclear Reactor Simulator

THE training of operational crews for nuclear power stations requires that, at some stage, they must have control equipment to practice with. It is desirable that, in universities and technical colleges, the instruction should not be entirely theoretical. To provide practical experience, in the absence of an actual reactor, a training simulator has been devised by Vickers-Armstrongs Ltd., London, England. It is based on analog-computer principles and, by means of electronic circuits, it will continuously solve the equations relating neutron flux with reactivity and time.

Basic experiments that it is designed to perform include starting procedure, running a reactor up, the approach to maximum power level, step changes in reactivity, doubling time and reactivity variations, and shutting down. The instrumentation covers all the important indications given on the control desk of a full-sized nuclear reactor. The equipment can be adapted to simulate operating conditions with various reactor fuels, up to a power level of 100 kw.

For use in conjunction with the simulator, a reactor core model is provided. This model shows the cross section of a graphite-moderated reactor with its shutoff rods, control rods, and fuel elements, the movement of the rods following those of the rods in the simulator. The fuel elements and rods are represented by colored strip lighting, the intensity of the light in the fuel elements varying with the conditions in the reactor from bright at full power to dark at shutdown. For lecture or demonstration purposes the reactor core model can also be operated independently of the simulator if required.

The apparatus is very compact, the simulator measuring only 6 ft 6 in. by 3 ft in plan and 4 ft 9 in. high. It is operated with a-c at 240 volts, and has a consumption of only 500 watts. Safety trips and interlocks are incorporated to produce the same responses as in an actual reactor.

Some members of the physics team of Vickers-Armstrongs (Aircraft) Ltd. South Marston Works, demonstrating operation of their newly devised nuclear reactor training simulator. A reactor core model for use in conjunction with simulator is on the right.

Substance in Brief of Papers Presented at ASME Meetings

ELEANOR RAMP
Edit. Asst.

ASME TECHNICAL DIGEST

Petroleum

Economic Selection of Steam and Power Supplies for Refineries and Petrochemical Plants..59—A-330... By D. L. E. Jacobs, Assoc. Mem. ASME, and W. B. Wilson, General Electric Company, Schenectady, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Horsepower requirements of compressor units or other process equipment in steam and power systems are several times what they were only a few years ago.

Higher management is actively interested in the increase in over-all profits that can be realized with a well-integrated and reliable steam and power system that minimizes any interruptions in the process.

Selection of boiler pressure is one of the first considerations in planning a new plant. This and other general system considerations that affect the economics of steam and power supplies are discussed.

Application characteristics of different steam and power systems and performance and cost data related to application of specific apparatus are presented.

By use of two examples with definite steam and power requirements, investment and operating costs are compared when different types of drivers and sources of electric power are selected.

Integration of the Power Recovery Gas Turbine With Fluid-Bed Processes..59—A-231... By J. C. Dygert, Assoc. Mem. ASME, and I. S. Bjorklund, Shell Development Company, Emeryville, Cal. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A 4000-hr operating test has shown that the combination of a special separator and a gas turbine can be utilized successfully to recover power from a particle-laden gas stream such as that from a fluid-catalytic-cracker regenerator or other fluidized-bed process.

A method is outlined for predicting turbine-blade erosion damage and blade life under erosive conditions, and various means of integrating the power-recovery turbine with the catalytic-cracking process are described as examples of possible applications.

Pressure-Vessel Overtemperature Hazards..59—A-319... By D. B. Rossheim, Fellow ASME, J. J. Murphy, Mem. ASME, G. P. Eschenbrenner, Mem. ASME, and R. S. Eagle, The M. W. Kellogg Company, New York, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Present codes for pressure equipment included provisions for overpressure protection but essentially omit considerations regarding overtemperature.

Accordingly, provisions to protect against the potential hazards of above-design metal temperatures resulting from auxiliary abnormal or emergency conditions or heat penetration are left to the discretion of the design or operating engineer without the advantage of code or other organized guidance.

In the interests of developing a philosophy and establishing essential principles for limiting the hazards of overtemperature, this paper reviews the nature, sources, effects, and means of detection and control of these hazards.

Suggestions for a rational design approach, operating precautions, and code coverage are presented. The discussion includes the particular problems of internally insulated vessels and contains a summary of experiences with internally insulated catalytic reformer reactors in several commercial installations.

The Strength of Thick Cylinders Subjected to Repeated Internal Pressure..59—A-167... By J. L. M. Morrison, B. Crossland, and J. S. C. Parry, University of Bristol, Bristol, England. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1960).

In April, 1956, the authors presented to The Institution of Mechanical Engineers a paper entitled "Fatigue Under Triaxial Stress: Development of a Testing Machine and Preliminary Results," and in September, 1956, a supplementary paper was presented to the International Conference on the Fatigue of Metals. These papers reported tests carried out on cylinders made from a $2\frac{1}{2}$ per cent Ni-Cr-Mo steel, which were subjected to (up to) ten million repetitions of internal oil pressure of (up to) 45,000 psi.

Since the publication of these papers a considerable amount of testing has been carried out on cylinders made from a carbon steel, a 3 per cent chrome steel, an austenitic stainless steel, a light alloy, a nearly pure titanium, the Ni-Cr-Mo steel in a harder state, and both the Ni-Cr-Mo steel and the chrome steel in the nitrided condition.

In addition, many tests of more academic significance have been carried out on the Ni-Cr-Mo steel in an attempt to achieve a better understanding of the extraordinary results which have been obtained.

This paper is concerned mainly with the presentation of the results (supported, of course, by ancillary tests on each material), which are of importance in design. Points of academic interest are discussed only when they are relevant to the practical problem. In order to make the paper reasonably self-contained, a brief summary of the previous work is given, together with a short description of the machine which has been developed for this work.

Influence Coefficients and Pressure Vessel Analysis..59—A-163... By G. D. Galletly, Assoc. Mem. ASME, Emeryville Research Center, Emeryville, Calif. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1960).

A description is given of the utility of influence coefficients for analyzing pressure vessels. To illustrate their advantages two relatively complex problems were selected and their final stress distributions calculated.

The problems were (*a*) a cylinder closed by a torispherical head and (*b*) a cylinder

joined to a smaller cylinder by an ellipsoidal-toroidal shell. Two vessels were analyzed using influence coefficients which have recently become available.

It is shown that accurate stress distributions can be obtained quickly and that a specialized knowledge of shell theory is not required. The method also shows the distribution of bending stresses throughout the shells. These latter, which can be important, are usually ignored by the various codes.

The Grand Isle Sulphur Mine Heating Plant and Underwater Sulphur Line Design..59—A-183... By C. M. Cockrell, Mem. ASME, Freeport Sulphur Company, New Orleans, La. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The Grand Isle Sulphur Mine is the third largest sulfur deposit in the United States and occurs in a salt-dome formation at a depth of 1800–2500 ft. The deposit is located in 50 ft of water in the Gulf of Mexico, 7 miles offshore from Grand Isle, La.

Mining is by the Frasch process which requires simultaneous heating of several wells by pumping in 325 F sea water for melting the sulfur. The liquefied sulfur collects at the bottom of the well where it is reclaimed by air-lift pumping.

The mine requires 5,000,000 gal per day of 325 F sea water for mining and up to 4500 kw electric power, 2500 cfm of 1000-psi air which consumes 13,000,000 cf/d of natural gas.

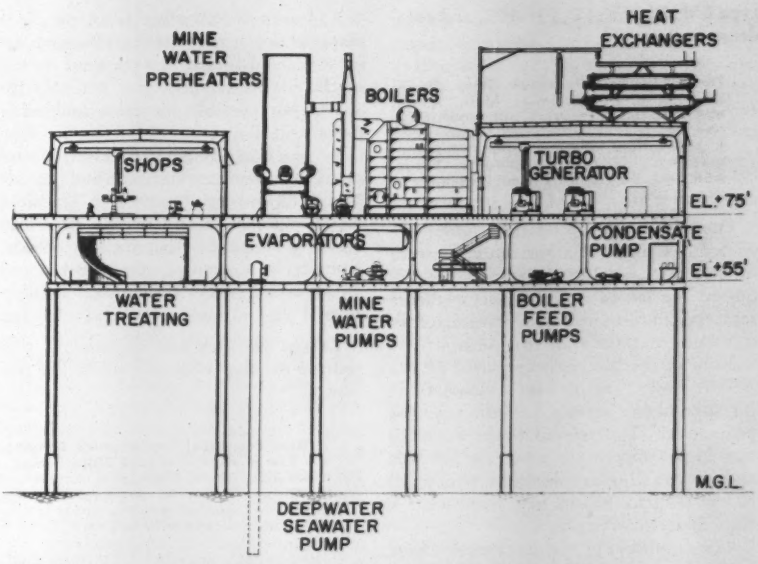
Most of the fuel supplied to the plant is used in heating the sea water for mining, with exhaust steam; thus the water demand controls the steam-generation requirement of the plant and makes it possible to obtain the high efficiencies.

Heating plant design features of the mine are described. Problems encountered in developing a design for the 35,000-ft underwater sulfur line are reviewed.

Tube Metal Temperatures for Structural Design..59—A-166... By E. E. Ungar, Assoc. Mem. ASME, Bolt Beranek and Newman, Inc., Cambridge, Mass., and L. A. Mekler (deceased). 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1960).

A simple procedure is developed for calculating the circumferential temperature distributions in tubes exposed to nonuniform radiation. Convection to the fluid in the tubes and circumferential conduction in the tube walls are accounted for, in addition to radiation.

Convenient dimensionless quantities are introduced and used for the presentation of graphs which facilitate rapid calculation of metal temperatures for structural design purposes. A calculation procedure using these graphs and a sample calculation are appended.



Section through the sulfur-mine heating plant situated on piles in the Gulf of Mexico. Structures supporting the steel platforms are designed for a maximum stress of 27,000 psi when subjected to 115-mph winds and 43-ft breaking wave forces in addition to the dead weight. (59—A-183)

The Theory of the Ideal Design of a Compound Vessel..59—A-125... By S. J. Becker, Westinghouse Atomic Power Division, Pittsburgh, Pa.; and L. Mollick, Mem. ASME, Baldwin-Lima-Hamilton Corporation, New York, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1960).

A general theory for the elastic design of a compound cylinder made by shrinking together many concentric cylinders is described. Each cylinder may have entirely different strength and operate at any temperature under any pressure, internal or external.

The only assumptions, in addition to the usual homogeneity and isotropy in each member, are that they have the same Young's modulus, although even different elastic moduli could be accommodated, and that they are not so thin that stability becomes a problem.

Power

Recent Boiler Design Practice..59—A-176... By W. H. Rowland, Mem. ASME, and E. G. Kispert, The Babcock & Wilcox Company, Barberton, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Design of steam-generating equipment depends upon the location and the type of fuels handled. It is necessary for fuel-preparation and burning equipment to be designed with sufficient flexibility that any fuel—solid, liquid, or gaseous—may be handled separately or together. Impurities in the fuel and in the feedwater greatly influence the design.

High cost combined with increasing demand for electric power make stand-by equipment economically impractical and make plants capable of operating with high availability, low maintenance, and high efficiency over the life of the equipment mandatory.

Superclean stacks and the extension of remote, centralized operation are becoming increasingly important to the power industry.

This paper indicates something of what The Babcock & Wilcox Company, as one steam generator manufacturer, is doing to further these ends.

Among the fireside factors covered are firing equipment, including stokers, pulverizers, burners, cyclone furnaces, feeders, and top-discharge crusher as well as boiler cleaning.

In the discussion of the design of the boiler furnace, construction, temperatures, cooling gas by radiation, and gas tempering are described. The problem of fireside deposition is presented.

Water treatment, natural circulation, and steam purity are included in the discussion of waterside factors. Also covered are superheaters and reheaters, including steam-temperature control and high-temperature corrosion, as well as economizers, air heaters, and pressure firing.

Typical designs for industrial boilers are given including shop-assembled boiler

type FM, FO, FF, FP, FH, PFI, and two-drum boilers.

The Eddystone Research Story..59—A-318...By E. C. Chapman, Mem. ASME, and R. E. Lorentz, Jr., Combustion Engineering, Inc., Chattanooga, Tenn. 1959 ASME Annual Meeting paper (multilithographed; to be published in Trans. ASME—J. Engng. for Power; available to Oct. 1, 1960).

The Eddystone supercritical boiler designed to operate at a maximum pressure of 5000 psig and 1200 F temperature required the use of new high-temperature materials in tubes and stop valves in order to avoid excessive wall thicknesses.

None of the materials approved by the ASME Boiler and Pressure Vessel Code for superheater service had the required properties. The present paper describes the high-temperature tests carried out and the welding development which led to the selection of the new materials for the supercritical panels.

The following conclusions were reached regarding the properties of these new materials:

1 17–24 CuMo steel has high-temperature strength superior to the strength of ASME-approved austenitic steels, and tubes of this analysis can be made using conventional steel-mill procedures. Tubes of this alloy can be fabricated without difficulty provided close control of heat-treatment is exercised.

2 Type 316 is a very satisfactory alloy for fabricating and has high-temperature properties which seem to testify to present stress code values.

3 Jessop G-18B alloy is an excellent material for many applications and deserves consideration as a material for use at the higher temperatures not only for valves but possibly for tubes and other parts.

4 The Fox CN-16/13 Co electrode appears to possess characteristic and provide high-temperature properties in deposited metal superior to any known American welding electrode. Satisfactory welds, completely austenitic, are possible and this is an important and unusual achievement.

Design features and fabricating procedures for the tubes and valves are presented.

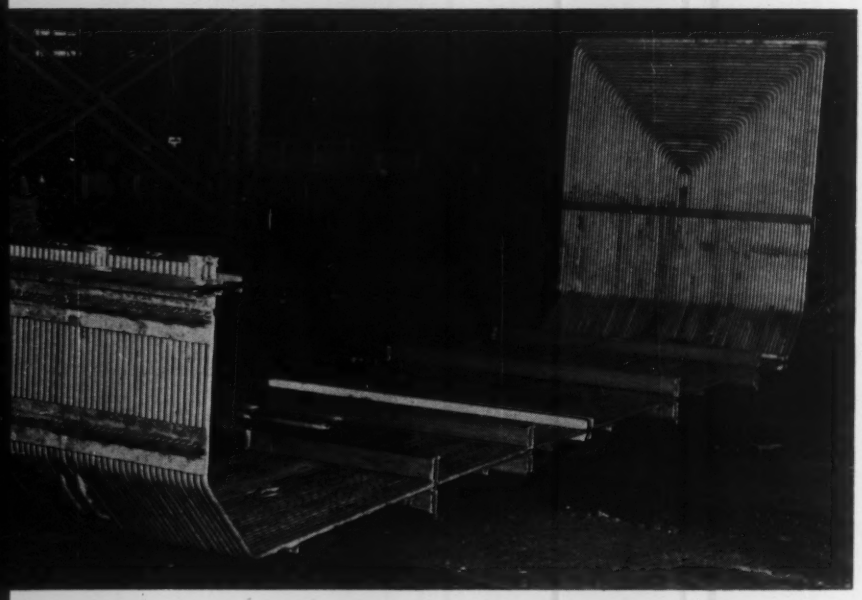
A New Sensitive Temperature Detector for Use in High Pressure Fluid Piping..59—A-201...By D. Robertson, Leeds and Northrup Company, Philadelphia, Pa. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

This paper describes the composite thermocouple method of obtaining fluid temperature changes within heavy-walled piping. This method has a sensitivity comparable to the familiar protruding well-type detectors used in low-pressure piping.

Unlike the low-pressure applications, however, the method requires virtually no protrusion into the fluid. The method uses the variation of the temperature gradient in the pipe-wall section to aid in indicating fluid temperature changes.

While results, on an experimental pipe using step temperature changes within, indicate that the thermocouple junction spacing and location of the detector assembly are somewhat critical, industrial installations probably will tolerate a considerably wider spacing and positioning range due to the existence of comparatively slower temperature changes.

Typical radiant superheater panel for Eddystone supercritical unit made of Type 316 and 321 tubes (59—A-318)



Recent Improvements in Load Capacity of Large-Steam-Turbine Thrust Bearings..59—A-139...By H. C. Bahr, Mem. ASME, General Electric Company, Schenectady, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Power; available to Oct. 1, 1960).

The load capacity of tapered-land and pivoted-shoe thrust bearings has been increased significantly by the use of materials with high thermal conductivity and by modified shoe designs.

Results of full-scale maximum-capacity tests at 3600 rpm and at 1800 rpm are presented. These tend to confirm that the interrelated factors of thermal distortion and bearing temperature significantly affect thrust-bearing performance.

Thrust-bearing capacity can be increased by the use of a high-conductivity backing material, such as copper. The improved tapered-land bearings have a capacity of 1300 to 2100 psi.

Modifications to a 254-sq-in. pivoted-shoe bearing provided a load capacity of 1210 to 1560 psi.

Research Problems Relating to Production and Quality Control of Ultrapure Feedwater for Eddystone Station..59—A-240...By J. A. Levendusky and V. J. Calise, Mem. ASME, Graver Water Conditioning Company, New York, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

This paper presents results of an investigation undertaken to date as part of the Eddystone Research Program to provide the information that is required to insure the production and quality control of the ultrapure condensate feedwater required for the Eddystone Station.

Pilot-plant data are presented on the filtration and demineralization process for treating condensates. Specific design features were incorporated into the design of the large-scale plant equipment on the basis of the pilot-plant data. Analytical measurements and the development of a new automatic instrument for measuring suspended solids are also discussed.

As a result of test work, the authors obtained basic information on the operating characteristics of the precoat filters and ion-exchange equipment which will permit the operation of this equipment in the most efficient manner.

They also found that (*a*) filtration is an important part of the purification cycle

for the removal of suspended solids; (*b*) iron and copper compounds will be reduced to the desirable levels and this is accomplished by filtration, not ion exchange; (*c*) in the event of a condenser failure the mixed-bed units will remove the solids and silica effectively; (*d*) a new analytical instrument, the Tape Analyzer, can be used to aid in monitoring the system to insure that ultrapure water is obtained at all times.

Development Associated With the Superpressure Turbine for Eddystone Station Unit No. 1..59—A-288...By W. E. Trumpler, Jr., Mem. ASME, E. A. Fox, A. F. LeBreton, and R. B. Williamson, Assoc. Mem. ASME, Westinghouse Electric Corporation, Lester, Pa. 1959 ASME Annual Meeting paper (multilithographed; to be published in Trans. ASME—J. Engng. for Power; available to Oct. 1, 1960).

Supplementing the 1956 report of the 325-Mw Eddystone Station steam-turbine generator unit No. 1,[1] this paper limits its scope to some of the unique features of the superpressure element of the turbine.

This single element will be recognized by the relatively few stages of blading as a comparatively small component of the whole machine. Yet this element, by receiving steam at 5000 psi, 1200 F, and expanding it to 2500 psi pressure at its exhaust, develops approximately 1/8 of the entire rated output of the cross-compound, double-reheat, turbine-generator set.

Thus the superpressure element presents unique problems with regard to the selection and procurement of alloys suitable for the high service temperatures, as well as the development of efficient shaft end seals which have to operate against unusually large pressure differentials while occupying relatively little space.

This paper describes the design, material selection, and testing of the superpressure turbine elements. It covers shaft seals, thrust, the superpressure integral-disk rotor, and alternate design of rotor, and blading.

Water-Treatment, Corrosion, and Internal Deposit Studies for Eddystone..59—A-147...By R. C. Ulmer, Mem. ASME, H. A. Grabowski, Mem. ASME, and R. C. Patterson, Mem. ASME, Combustion Engineering, Inc., New York, N. Y. 1959 ASME Annual paper (in type; to be published in Trans. ASME—J. Engng. for Power; available to Oct. 1, 1960).

Since water conditions could well decide whether the 5000-psi 1200-F Eddystone unit could be operated satisfactorily, every condition which might lead to a problem was given careful consideration. Tests at supercritical pressure indicated that a considerable amount of "soluble salts" deposited in the 850 to 950-F range when initially present at 2.0 ppm.

Less deposition occurred with potassium salts than with sodium, but it was sufficient to make careful control of solids in the whole system imperative. This will be accomplished by demineralization of the make-up and by bypass demineralization of condensate as required.

When present in the amount anticipated for Eddystone, even at 1200 F there was no measurable decomposition or deposition of salts.

As to corrosion, proper control of dissolved oxygen and maintaining 10-ppb hydrazine and sufficient ammonia to give an 8.5 to 9.5 pH range insured low metal pickup. Thus deposition of metallic oxides in the boiler and turbine does not appear to be a problem. Corrosion tests and metallographic examination of the various alloys used indicate no harmful loss of metal or change in structure, hence no service-life problems are expected.

Pilot-Plant Water Studies for Eddystone Station..59—A-260...By F. N. Megahan, Philadelphia Electric Company, Philadelphia, Pa. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

An extensive two-year pilot-plant program was undertaken to study methods of treatment of the city water supply to provide the highest quality make-up water for the supercritical boilers.

Fouling of Type II anion resins in mixed-bed serive was encountered. Zeolite softening as pretreatment was of no help, but activated carbon did prolong resin life. Type I anion resins withstood fouling with only sand-filter pretreatment.

A two-bed, mixed-bed system using 8 1/2 per cent cross-linked cation resin and nonporous Type I anion resin in all units was found to give consistently high-quality water and was adopted as the type of plant to be installed in Eddystone Station for boiler make-up.

Material Selection and Fabrication, Main Steam Piping Eddystone No. 1, 1200-F and 5000-Psi Service..59—A-327...By R. H. Caughey and W. G. Benz, Jr., M. W. Kellogg Company, Jersey City, N. J. 1959 ASME Annual Meeting paper (multilithographed; to be published in Trans. ASME—J. Engng. for Power; available to Oct. 1, 1960).

Eddystone No. 1, the 325,000-kw generating plant of the Philadelphia Electric Company, which has been designed for 1200-F temperature and 5000-psi steam pressure at the superpressure turbine throttle, represents a historical advance in the search for more electrical energy from each ton of fuel.

Engineers in establishing the size, steam conditions, and heat cycle for Eddystone encountered problems in selecting materials capable of withstanding continuous operation at the extremely high temperatures and pressures; Eddystone steam conditions being more severe than those in any existing utility.

The main steam piping system, the subject of this paper, which carries the dense steam at a temperature of 1200 F and a pressure of 5000 psi and at flow rates between 600,000 and 2,000,000 lb per hr from the superheater header to the turbine throttle, was a particularly important materials problem requiring an exhaustive study of many high-alloy and superstrength steels.

This paper presents the results of the metallurgical investigation which led to and supports the selection of Type 316 stainless steel (17 Cr—13 Ni—2.5 Mo) piping and a welding electrode of 16 Cr—8 Ni—2 Mo composition for fabricating the main steam system of Eddystone No. 1.

High lights in the manufacture of the large main steam pipe system with particular reference to the steel production, pipe production, hot bending, welding, heat-treatment, and the allied quality control procedures which were deemed necessary in the light of the critical service are described.

Integration of Turbine-Driven Boiler Feed Pumps in Large Power Plants..59—A-196 ...By E. L. Pace, Assoc. Mem. ASME, General Electric Company, Fitchburg, Mass. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Inherent advantages that have prompted recent active interest in steam-turbine drives for large boiler feed pumps are reviewed. These advantages are as follows:

(1) Economic evaluation of increased net kw output of plant; (2) improved net heat rate; (3) saving of space in station; (4) variable-speed drive; (5) direct connection to pump; (6) effect on pump net positive suction head; (7) reduction in capacity of electrical auxiliary power system; (8) effect on auxiliary bus transfers; (9) reduction in electrical power requirements for starting; (10) simplification of piping under reheat turbine; (11) reduction of extraction temperatures to heaters; (12) flexibility of adjustment to operating conditions; (13) warming of main steam line.

Basic principles of arrangement and design of heat cycles for power plants are essentially the same as have been used for

[1] C. B. Campbell, C. C. Franck, J. C. Spahr, "The Eddystone Superpressure Unit," *Trans. ASME*, vol. 79, 1957, pp. 1431–1446.

many years, with some modifications as described.

The importance of designing the cycle as an integrated whole and the particular points of emphasis in such design are discussed. These lead to optimization of the cycle to take full advantage of opportunities offered by turbine drives, to obtain the best balance of investment cost per net kilowatt output, net heat rate over the load range, and ease and economy of operation and maintenance.

Development of Floating Ring Type Stuffing Boxes for Eddystone Boiler Feed Pumps..59—A-259... By Alexander Brkich, Ingersoll-Rand Company, Phillipsburg, N. J., and R. E. Allen, Mem. ASME, Ingersoll-Rand Company, New York, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Plant size increases with higher pressures, and temperatures made it necessary to redesign boiler-feed-pump stuffing boxes. Earlier experience with floating rings in boiler circulating pumps led to several trial installations in boiler feed pumps.

A special field tester was built to verify engineering calculations, and after minor changes the pumps were built and tested successfully in the shop.

This paper concludes that floating-ring-type stuffing boxes have much to offer the utilities because:

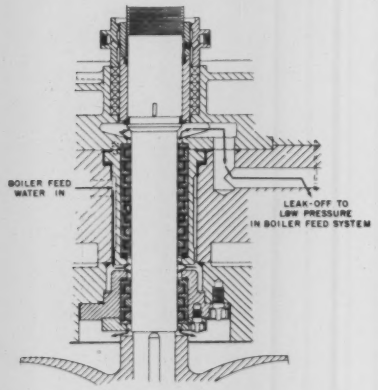
1 They require less maintenance than conventional packing or mechanical seals.

2 Owing to their adaptability they can be run at close clearance to keep leakage to a minimum.

3 Their design can easily be tailored exactly for a given suction condition and available injection and bleed-off.

4 The authors' company's successful experience on boiler circulating pumps and on boiler feed pumps indicates this is the best method known to date to handle unusual suction conditions. A unit has never been shutdown due to floating-ring, stuffing-box problems.

Section of a stuffing-box injection-type boiler circulator (59—A-259)



Gas Turbine Power

Design and Development of a Convective Air-Cooled Turbine and Test Facility..59—A-282... By W. F. Weatherwax, General Electric Company, Lynn, Mass. 1959 ASME Annual Meeting paper (multilithographed; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1960).

Demands for higher jet-engine thrust-to-weight ratios to satisfy the needs for high Mach number and vertical take-off aircraft are continually increasing. Since World War II, the threefold increase in thrust-to-weight ratio can be attributed almost entirely to the development of lightweight construction and the axial-flow compressor, and little credit can be given to the meager 200-F increase in turbine-inlet temperature.

Increasing turbine-inlet temperature, beyond present-day material limits of 1600-1700 F, by convective air cooling, will increase the jet-engine thrust-to-weight ratio and will improve markedly the performance of the turboprop and by-pass engines.

This paper reports the partial results of a program undertaken by the author's company to develop a fully convective air-cooled, flight-type, single-stage turbine to demonstrate the feasibility of operation at an average inlet temperature of 2000 F, with 4.3 per cent of compressor discharge cooling air.

Discussed are the design heat-transfer considerations, description of the test facility, and performance results obtained to date.

From the testing to date, the following conclusions are made:

1 The test facility has been debugged and developed sufficiently to allow high-temperature testing for mechanical reliability and cooling effectiveness. In addition, low-temperature aerothermodynamic testing can be done.

2 To date, test results have shown no evidence of inadequate cooling with design cooling flows.

3 More endurance testing is needed to establish mechanical reliability.

4 Rotating instrumentation yielded useful information on bucket strut temperatures.

5 There is no evidence of cooling-passage clogging.

6 The design procedure is adequate and will be used again for future designs.

7 Manufacturing and inspection techniques, developed during this program, make possible low cost production of this type blading.

The Radial Turbine, for Low Specific Speeds and Low-Velocity Factors..59—A-294... By E. M. Knoernschild, The Garrett Corporation, Los Angeles, Calif. 1959 ASME Annual Meeting paper (multilithographed; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1960).

Radial turbines have established their place in industry, especially in the field of small turbomachinery, because of their simplicity, ruggedness, and reliability. Though in most cases the field of application is tailored to the usual 50 per cent reaction, many applications are indicated for turbines to operate at much smaller reaction in order to approach the performance range of impulse-type axial turbines.

Also, more and more applications are found in the field of low specific speeds where the radial turbine's competitor, the axial turbine, may operate with partial admission.

This paper attempts to shed some light on the problems encountered in obtaining efficient radial turbines, especially for very low specific speeds and those running close to zero reactions (impulse type).

After a short description of the losses in radial turbines, the concept of the diffusion parameter is introduced. It is shown how the turbine geometry influences performance and, in particular, the reaction.

The influence of a variation of the reaction on performance of radial turbines with high and low specific speed is discussed. Three-dimensional effects appear especially in the exducer region of the turbine. They may contribute to backflow and to a distorted distribution of the meridional velocity.

It appears that an attempt to reach impulse conditions in radial turbines is difficult, and only a rather small efficiency improvement can be expected. The approach to be taken in adapting a turbine design to low-specific-speed operation is pointed out, and the deterioration of the blade loading pattern due to such a reduction of the specific speed is shown.

Marine and Mobile Applications of Industrial Gas Turbines..59—A-295... E. O. Kohn, Ruston and Hornsby Limited, Lincoln, England. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The class TA gas turbine was conceived as a general-purpose machine for stationary duty. During the past 5 years it has established itself as a reliable prime mover in the oil fields and as a producer of power and process heat in industry.

This paper deals mainly with the service experience on a deck-mounted installation of this standard industrial gas turbine, and shows how the type of in-

General arrangement of class TA gas turbine which has a 13-stage axial compressor driven by a 2-stage turbine at 12,000 rpm (59—A-295)

stallation evolved has been adapted for general mobile applications.

After a critical examination of *HMS Cumberland*, the British Navy's cruiser used for testing new equipment, a TA gas turbine was installed in a specially built house, to provide additional generating capacity. It was found after two trial seasons with 3000 hr of miscellaneous testing that the plant as fitted was compact and readily accessible for operation and maintenance, could be brought into use at extremely short notice, and that rapid and varied load changes could be accepted readily and reliably.

The turbine also was adapted to suit a rail-borne plant.

A description is given of a new 430-hp industrial unit, designed with marine requirements in mind. The application of its design concepts to a new class of turbine is briefly discussed.

Aviation—Reliability

Unique Aspects of the F4H Airplane Reliability Effort..59—A-299...By G. A. Kunznick, McDonnell Aircraft Corporation, St. Louis, Mo. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A description is given of the effort involved in the planning and attainment of mission and safety reliability for the McDonnell F4H Phantom II weapon system. Some of the unique aspects of this effort include design reliability through judicious use of redundancy, the procurement of reliable systems from subcontractors through specification requirements and reliability programs, and an integrated failure reporting system utilizing the Navy FUR-AAR System.

It is believed that the following aspects of this effort warrant their being called unique:

1 The F4H airplane is the only jet fighter that is fully redundant in all primary systems and currently being procured by the Navy.

2 The specifying of reliability quantitatively into procurement documents over 3 years ago represents one of the earliest attempts to obtain such contractual commitments.

3 The utilization of the Navy FUR-AAR data to improve a new airplane design was one of the earlier efforts.

This presentation gives some of the reasoning that went into the F4H airplane without attempting to describe other reliability efforts, such as design reviews, stress analysis, prediction, and education.

Distribution of Service Lives of Hydraulic Pumps..59—A-300...By J. de S. Coutinho, Mem. ASME, Grumman Aircraft Engineering Corporation, Bethpage, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

This paper reports the progress being made on the development of a method for establishing the distribution of the service lives of hydraulic pumps under actual environmental conditions in the Naval Air Service. The method is based on an analysis of reports furnished by the operating activities, such as the Navy FUR reports. The raw data are processed into a cumulative failure probability curve.

It is assumed that this sample is taken from an infinite population which can be represented by a theoretical distribution. Five theoretical distributions are considered: The normal, the log normal, the gamma, the Weibull, and the exponential distributions. Each of these theoretical distributions is combined with the aircraft operating time of the sample, and an expected true cumulative failure probability is computed for each distribution. These probability curves are compared with that of the sample, and the theoretical curve with the best resemblance to the sample is considered the best estimate of the true distribution.

Corrosion and Deposits

Corrosion of Superheaters and Reheaters of Pulverized-Coal-Fired Boilers..59—A-89...By Wharton Nelson and Carl Cain, Jr., Combustion Engineering, Inc., Chattanooga, Tenn. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power**; available to Oct. 1, 1960).

Several years ago inspection of the reheater and finishing superheater tubes in a 1055-F, 1005-F boiler firing pulverized midwest coal revealed considerable external corrosion loss of tube metal. Significant corrosion occurred in a number of points in common to the affected boilers. A research program was established to determine the cause and prevention of accelerated wastage.

A description of the study of the corrosion mechanism constitutes most of this paper. Remedial measures are suggested. A conclusion is drawn that shielding lead tubes in the deposit-forming areas of the finishing reheater and superheater, where skin-metal temperatures are between 900 and 1400 F, is the best practical means for preventing accelerated liquid-phase corrosion in pulverized-coal-fired units.

An Experimental Investigation of Fuel Additives in a Supercharged Boiler..59—A-160...By R. J. Zoschak, Mem. ASME, and R. W. Bryers, Assoc. Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1959 Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power**; available to Oct. 1, 1960).

To permit the use of high-vanadium residual oil as fuel for combined supercharged-boiler gas-turbine power plants, it is necessary to determine the treatment required to prevent the high-temperature corrosion and deposit problems associated with this fuel.

A test program has been undertaken wherein a number of magnesium and aluminum-bearing additives have been injected into washed residual oil when firing a laboratory-scale, simulated super-

charged boiler. Different tube arrangements within the boiler have been tried.

Ash collected on the tubes at various locations has been analyzed and its corrosive effect at high temperatures on some types of stainless steel has been evaluated. The results thus far obtained are presented together with some hypotheses regarding the formation of deposits.

External Corrosion of Superheaters in Boilers Firing High-Alkali Coals..59—A-76... By P. Sedor, Assoc. Mem. ASME; E. K. Diehl; and D. H. Barnhart, The Babcock & Wilcox Company, Alliance, Ohio. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1960).

In the past few years, corrosion of high-temperature superheaters and reheaters has become an increasingly serious problem on coal-fired boilers. The nature and occurrence of corrosion observed on several boilers in the Chicago area which burn high-alkali coal are described.

Some of the results obtained from an experimental study of the factors involved, and the control measures applied to prevent further serious loss of tube metal are presented.

Human Factors Engineering

Improving Man's Workload in Space Vehicle Systems: Methodology and Measurement..59—A-195... By A. J. Latham, Chance Vought Aircraft, Dallas, Tex. 1959 ASME Annual paper (multilithographed; available to Oct. 1, 1960).

The secret of man's survival in this world of hostile environments would seem to be his ability to adapt himself to the environment. Often this takes the form of changing the environment, as in the case of heating and air conditioning.

The first requirement for man's workload in space-vehicle systems is the creation of a suitable environment. It must be optimum for both economy and feasibility of operation.

Such enormous cost of putting a pound in orbit requires that each pound be essential to the mission. Aside from humanitarian considerations, maximum realization of the benefits of the venture require maximum likelihood that the crew will return safely.

This discussion describes procedures that will implement the development of efficiency and economy of optimum workload in space vehicles. A biological environment must be provided that is compatible with effective human function. A program of human engineering of displays and controls must be undertaken. This involves analysis of human function in the system based on the requirements of the system. Lastly, the relationship of such a program to the areas of design, personnel, and training will be described.

Man's Response to Low-Frequency Vibration..59—A-200... By M. A. Schmitz and A. K. Simons, Assoc. Mem. ASME, Bostrom Research Laboratories, Milwaukee, Wis. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

This study deals specifically with the effect of low-frequency, large-amplitude vertical whole-body vibration on human psychomotor performance.

Although vibrating motions are inherent in all transportation vehicles, comparatively little is known of how these vibrations may affect operator performance. The study was initiated to ascertain what types of performance might be affected.

The following psychomotor tests were chosen for study: the hand-tremor test, body-sway apparatus, visual acuity, simulated driving task, compensatory tracking, foot-pressure test, and foot-reaction time.

It appears that tasks involving vision and muscular co-ordination may be most affected by low-frequency, high-amplitude vibration. Hypothetical charts are presented showing postulated performance decrement over the low-frequency range as a function of input intensity and frequency. It is felt that, with the completion of our present studies from 1.5 to 6.5 cps, these charts can be finally plotted.

How Common Is Common Sense?..59—A-258... By P. L. Flatow, New York University, Bronx, N. Y.; and G. M. Weeks, Assoc. Mem. ASME, Gene Weeks and Associates, New York, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Common sense, though fraught with pitfalls, can still be a valuable tool when it is bulwarked with sound statistical inference, a process in which statistics attempts to sample from the real world and then generalize about the population. There are pitfalls in overdoing statistics and assuming that the magic of mathematics will cover up faulty reasoning.

The critical phase of any research operation is the design of the experiment, and it is here that statistics, if manipulated skillfully as a tool rather than as an end in itself, can be invaluable.

The easiest approach to the notion of a statistical model is through population models and includes three avenues: (*a*) A tabular sample of experimental values from which an average or mean can be approximated; (*b*) a graphical representation wherein the proportion of data found in any interval is equal to the area of the rectangle above the interval; (*c*) a mathematical model.

The applications of statistical models is necessary in the real world because so often an engineer is dealing with only fractions of a population, or only has time for a few tests which can be costly or destructive. He will then find very valuable such tools as the test of hypothesis, or such applications as the difference of two sample means or tests of reliability.

In the field of human engineering, it is more than critical to design one's experiments with sound scientific method as the subject, man, is such an uncontrolled variable. Sound statistics will help to buttress intuition and common sense, so that you can make initial assumptions within the rigors of good engineering practice.

Fuels

Protecting Industrial Furnaces From Explosions..59—A-274... By M. L. Jones, Mem. ASME, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Protection of industrial boilers from explosions and maintenance of high reliability of the units is not easily accomplished at present. Furthermore, it is difficult to get a group of power engineers to agree on what constitutes a safe boiler free from potential furnace explosions.

These problems are discussed for liquid or gaseous fuel-fired boilers with a maximum size of 100,000 lb per hr. Included in the discussion are causes of furnace explosions, human versus instrument-operated boilers, safety equipment, methods of detecting a flame, kinds of detectors, and the application of safety devices, and reliability of power supply to instruments.

The problem of providing economical, safe, and reliable furnace protective systems rests on these basic decisions:

1 To what degree is automatic control essential?

2 What function failures in a system require shutdown of the unit for protection?

3 How can the components protecting the system be readily checked?

The author suggests a standardization of protective components of the systems to provide a safe, reliable way for protecting industrial furnaces from explosions.

Boiler Furnace Fuel Explosion Survey.. 59—A-303...By J. B. Smith, Factory Mutual Engineering Division, Norwood, Mass. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Fuel explosions in manual-lighted boiler furnaces firing gas, oil, and pulverized coal, were analyzed to develop practical prevention methods. The explosions were divided into three major groups depending upon operation of burners at time of explosion: (*a*) lighting-off at cold furnace; (*b*) firing; and (*c*) nonfiring or relighting of warm furnace.

For each fuel there were five causes which accounted for a majority of explosions with that fuel. Eight different causes accounted for about 70 per cent of the total explosions for the three fuels.

These eight causes are described in the following table.

Frequency of Fuel Explosions in Manual-Lighted Boiler Furnaces 1936–1956

Cause code no.	Cause	Per cent of number of explosions		
	Initial lighting-off	Gas	Oil	Coal
C-1	Too long or repeated manual attempts to light off	20.4	12.6	6.7
C-3	Accidentally open burner cock	8.2	0	0
	Total	28.6	12.6	6.7
	Firing			
B-1	Flame failure—no air deficiency—no attempt to relight	12.3	12.6	20.2
B-2	Insufficient air for complete combustion	18.4	13.4	14.9
B-3	Incomplete combustion—low furnace temp or poor atomization	0	15.7	...
B-4	Incomplete combustion-coal feed obstructed or varied excessively	0	0	18.9
	Total	30.7	41.7	54.0
	Relighting or nonfiring			
D-2	Flame failure with attempt to relight	14.3	8.6	...
D-7	Passage of unburned coal into furnace	0	0	16.2
	Total	14.3	8.6	16.2
	Subtotal	73.6	62.9	76.9
	C—Initial lighting-off, miscellaneous	12.2	5.5	0
	B—Firing, miscellaneous	2.0	10.3	17.6
	D—Relighting or nonfiring, miscellaneous	8.1	15.0	5.5
	Miscellaneous total	22.8	30.8	23.1
	Insufficient data	4.1	1.3	0
	Total	100	100	100

Lessons from the pulverized-coal-firing explosion experience are given special attention with reference to pilots, purging, flame-protection equipment, and automatic combustion controls.

Pressurization of Granular Solid Fuels.. 59—A-150...By M. N. Aref, Mem. ASME, Foster Wheeler Corporation, New York, N. Y. (In type; to be published in Trans. ASME—J. Engng. for Power; available to Oct. 1, 1960).

The different methods of pressurizing powdered solid fuels which have been developed are reviewed briefly, including proposals as well as those in operation. The work has been devoted particularly to a study of the characteristics of these pressurizers, in relation to their common problems of: (*a*) Power loss due to venting the pressurizing air, (*b*) wear of the surfaces in contact with the solids, and (*c*) effective sealing.

The most practical methods have been compared on power loss, rather than power required in their cycles.

It has been found that power loss due to air venting cannot be totally eliminated and that the simple lock hopper is, so far, the best available device which has the lower capital cost, maintenance requirements, power loss, and better reliability.

Where space is of major importance, however, the lock hopper with a moving wall can be considered as an alternative, though it may suffer from an increased wear rate and a reduced volumetric efficiency.

American Coal Characteristics and Their Effects on the Design of Steam Generating Units..59—A-242...By A. F. Duzy, Assoc. Mem. ASME, The Babcock & Wilcox Company, Barberton, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Manufacturers of coal-burning steam-generating equipment must keep abreast of all methods of evaluating coal characteristics. Since all coal contains ash, the designer of high-pressure, high-temperature steam generators must have a thorough knowledge of ash characteristics and their effect on boiler surfaces.

The designer of fuel equipment and boilers requires simple, reproducible, dependable laboratory tests and analyses of coals to predict their behavior.

The characteristics of coal and their effects on the design of steam generators, including the major components from the coal bunker outlet through the fuel equipment, furnace, convection sections, air heaters, and dust collectors, are discussed in this paper.

Stoker-fired boilers are considered separately from boilers fired by pulverized coal or cyclone furnaces. Emphasis is placed on the impurities in coal and their effect on the major components of large, coal-fired steam generators.

The Direct Method of Testing Heating and Power Boilers..59—A-284...By E. P. Carman, Mem. ASME, Fuels Consulting and Testing Associates, McLean, Va. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Advantages and requirements for direct input-output testing of heating and power boilers in accordance with ASME codes to determine compliance with purchase specifications as regards performance and efficiency are cited.

Reasons why the Bureau of Mines and the author's organization prefer this method whenever it can be used are given, along with the methods used, and essential, for calibrating instruments and test equipment.

The paper will give those responsible for purchasing, testing, and using heating and power boilers a better conception of the advantages, as well as the problems involved, in using the direct method of testing so that they may more easily decide whether this method is best suited to their purchase specifications and conditions.

The Combustion of European Coals in Modern German Steam Generators.. 59—A-194...By P. Pracht, H. Hennecke, and G. Redottee, Deutsche Babcock und Wilcox-Dampfkessel-Werke AG, Oberhausen (Rheinland), Western Germany. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

European fuels being fired in modern steam boilers differ from the American fuels known to us especially by their, on the average, high content of ballast and lower portion of volatile matters.

Moreover, the occurrence of coal being workable according to American ideas is insufficient for the European energy requirements.

Therefore there are mined fuels being partially rather low-grade. The low-grade fuels are treated by washing. In this way there are obtained salable fuels and preparation residues hard to sell, so-called middlings. In order to increase the profitability of the mines, the middlings are burned in steam power stations especially erected in mines.

This report gives a general view on the combustion of European coals in steam generators. The different qualities of the fuels are discussed and special problems are dealt with regarding their final treatment for combustion, their firing, and the boiler construction.

Application of Model Studies to Industrial Gas-Flow Systems..59—A-280... By C. L. Burton, Mem. ASME, and R. E. Willison, Research-Cottrell, Inc., Bound Brook, N. J. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Correlation of gas-flow patterns between scale models and full-size systems for industrial electrostatic precipitators and flues is presented.

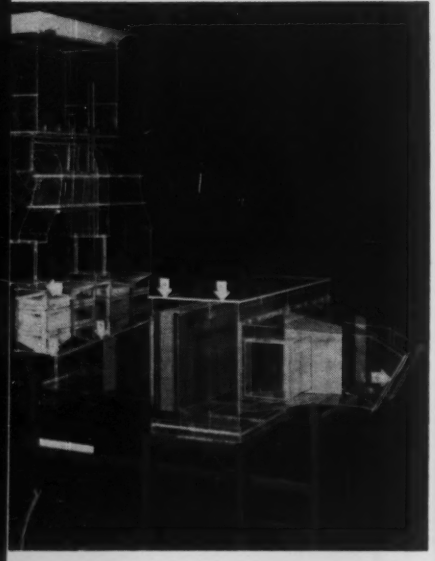
For many years, precipitators were designed to meet a guaranteed collection efficiency regardless of the quality of gas flow imposed by the design of the connecting flues. This has meant that the precipitator was made oversize and correspondingly expensive to cope with poor gas and dust distribution. Today, precipitators for central stations are required to clean 500,000 to 1,400,000 cfm of gas with guaranteed efficiencies of 95 to 99 per cent. Space is of prime importance to obtain the best possible gas flow.

To overcome the limitation of rule-of-thumb design, investigation of the use of gas-flow models was begun in 1950. Transparent models have an important advantage since a specific gas-flow pattern can be viewed in its entirety from source to final effect. Flow patterns can be determined by direct observations and measured velocity profiles.

Several instances are given showing successful correlation of model and field results as evaluated by improvement in gas-flow distribution, reduction of elimination of dust dropout over a range of operating conditions, and duplications of flow patterns in both the model and full-size systems as a result of system geometry.

Industrial-flue studies are simplified since flow patterns are usually the primary variable to be studied. These studies provide additional evidence that the scale model is an important technique in designing gas-flow systems since model studies duplicate and predict the flow patterns to be found in full-size industrial gas-flow systems.

A typical scale model of an electrostatic precipitator system complete from economizer outlet, connecting flue, air preheater, inlet flues, electrostatic precipitator, and outlet flue stopping at the ID-fan inlet flanges (59—A-280)



Railroads

Impact as Related to Freight-Car and Lading Damage..59—A-249... By W. E. Baillie, Mem. ASME, National Malleable and Steel Castings Company, Cleveland, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Damage to railway cars and ladings resulting from end impact is responsible for direct and indirect losses to the American railroads probably exceeding $100,000,000 annually.

The subject of impact as related to freight-car and lading damage was therefore chosen by the author's company for research study and exploration on the impact track as a basis for the development of efficient car-cushioning products.

The first part of the paper provides an analysis of the physics of impact. Next, the paper reports railway-car impact studies which were made to determine the relation between car cushioning and disturbances to cars and ladings during impact.

Increased Cushioning Capacity—A Requirement of Tomorrow's Freight Car..59—A-224... By R. E. Abbott, Association of American Railroads, Chicago, Ill.; and H. K. Lanning, Mem. ASME, Atchison, Topeka, and Santa Fe Railway Company, Topeka, Kan. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Draft-gear equipment that will be used on tomorrow's freight car will be tailored in design to meet the protection requirements of that specific type of car operation. Appraisal of plans for the car indicates that railroad officials are becoming more aware of the acute need for additional protection to both the freight car and the lading transported in it.

Future requirements in draft-gear designs in order to insure proper protection to the freight-car structure and the lading transported are discussed in this paper.

Evolution of the conventional freight-car draft gear, economic results of inadequate cushioning capacity, fundamentals of cushioning, and effect of overspeed impacts on design are covered besides the avenues of approach to increased cushioning capacity.

The economic benefits that may be derived from increased draft protection are pointed out and new devices that provide increased gear capacity at low reaction forces are discussed.

It is concluded that the practical embodiment of the means of improving cushioning capacity for future railroad equipment provides high-capacity draft gears for car structures designed for handling bulk type commodities, long-travel draft gears, affording moderate protection to rugged-type lading, and cars having sliding underframes or suitable cushioning devices for protection of fragile lading.

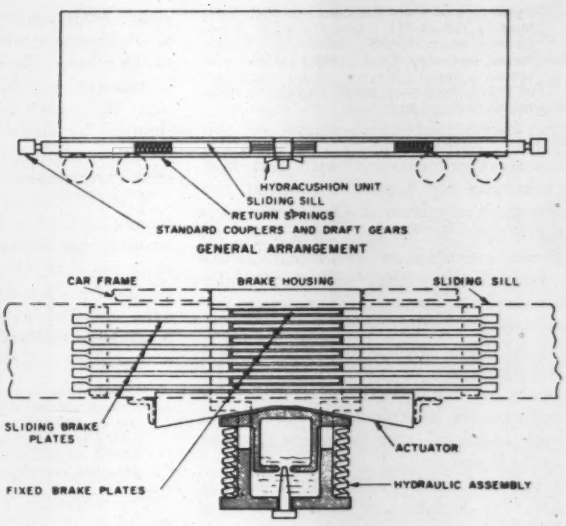
The Santa Fe Shock Control Freight Car..59—A-221... By T. T. Blickle, The Atchison, Topeka, and Santa Fe Railway Company, Chicago, Ill. 1959 Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The cost of loss and damage to the American railroads has been steadily increasing through the years and amounted to over 114 million dollars in 1958. In addition to this monetary loss, a loss of good will is frequently associated with a loss and damage claim, with the result that the railroads often lose a customer to some other form of transportation.

A good share of the damage that is being experienced is from impact shocks; consequently, the development of equipment to better protect the commodities that the railroads haul is one of the most important phases of this problem.

To reduce damage from shocks it became quite apparent that freight cars must have greater cushioning capacity, and a research program was initiated to develop a suitable cushioning arrangement. A hydraulic cushioning device appeared to be the best choice from the standpoint of a smooth operation, high capacity, lack of recoil, and adequate travel at all impact speeds.

As a result of tests on the shock-control underframe developed in the program, 100 boxcars were constructed and assigned to handle fragile commodities. Their performance was outstanding and 100 existing cars were equipped, followed in early 1959 by a 500 new-car program. The Santa Fe is now undertaking the construction of 1000 addi-



Hydracushion underframe unit now used by the Southern Pacific Company to improve shock absorption on freight equipment (59—A-198)

tional cars equipped with the shock-control underframe.

The Hydracushion Underframe and Its Contribution to the Reduction of Lading Damage..59—A-198... By S. M. Houston, Southern Pacific Company, San Francisco, Calif. 1959 Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

High capacity alone in a draft gear will not protect the car structure or lading. The capacity and length of gear travel are closely interrelated and must be considered jointly when designing a cushioning device which will afford maximum protection.

Such a device is the hydracushion underframe which combines the desired characteristics of a hydraulically controlled friction brake and at the same time provides a reasonable length of travel over which to distribute the impact loading.

The major components of the hydracushion gear are the sliding draft sill with centering springs, the friction plates, and the hydraulic cylinder. The sliding draft sill extends the entire length of the car and is provided with a standard draft-gear pocket and coupler at each end.

In the center of the sliding draft sill is a set of flat plates and an inclined plane which are attached to and move with the sliding draft sill. The friction brake is a stack of intermeshed plates which absorbs the impact energy. One half of the plates are attached to and move with the sliding draft sill. The other set of plates is stationary and is attached to the center sill of the car underframe.

The contact pressure between these stationary and moving plates is controlled by the movement of the sill and resultant pressure in the hydraulic cylinder. The hydraulic cylinder is rigidly attached to the underframe. The piston of the hydraulic cylinder is actuated by an inclined plane which moves with the sliding sill. This piston travels vertically within the cylinder and reacts upward against the stack of friction plates.

The hydraulic pressure within the cylinder controls the force with which the friction plates are clamped together. To give a variable pressure in the cylinder and thus a variable friction or resistance to the movement of the sliding sill, the flow of oil in the hydraulic cylinder is controlled by an orifice and metering pin arrangement.

Solar Energy—Heat Transfer

Solar Air Conditioning With an Ammonia-Water Absorption Refrigeration System..59—A-276... By Melvin Eisenstadt, The Martin Company, Orlando, Fla.; F. M. Flanigan, Assoc. Mem. ASME, University of Florida, Gainesville, Fla.; and E. A. Farber, Mem. ASME, University of Florida, Gainesville, Fla. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Air conditioning is a natural application of solar energy since the sun is used to overcome its own discomforting effect. The near coincidence of maximum cooling load with the period of greatest solar radiation is an advantage since the greatest cooling effect is available when needed most.

In this paper an ammonia-water absorption-refrigeration system utilizing hot water from a flat-plate solar absorber for regeneration is presented as a method of comfort cooling with solar energy. The temperature of the hot water used for regeneration varies from 140 to 180 F, a range readily obtained with present-day commercial flat-plate absorbers. An intermittent cycle was tested and the resultant performance is reported.

Determination of the effects of hot-water temperature and ammonia concentration on system performance, the practicality of the system, and the application of the results of an intermittent cycle to a continuous cycle are objectives of the paper. Data collected indicate that such a system is thermodynamically feasible.

Solar Turbo Power-Plant Design..59—A-74... By D. B. Mackay and E. L. Leventhal, North American Aviation, Inc., Downey, Calif. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1960).

Design and performance characteristics of a lunar-based turbo power plant actuated entirely by solar radiation are discussed. The obvious limitation of solar power on the lunar surface is a long shutdown period caused by the lunar night. However, investigation of power needs has shown, for example, an important refrigeration requirement existent during the lunar day—offering an interesting match of power needs with solar power capability.

The generation of power from solar radiation on the moon, as in space, is aided by the absence of an atmosphere. This paper proposes a method whereby solar radiation on the moon can be converted into usable energy.

Factors affecting power-plant design and a discussion of a performance basis for a working fluid are also presented. Graphs and equations which illustrate theory, optimize results, and demonstrate intercomponent relationships are included. A design for a compact power plant is introduced.

Textiles

The Interaction of Textile Structures and High-Speed Textile Processes..59—A-115... By H. M. Morgan, Fabric Research Laboratories, Inc., Dedham, Mass. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1960).

Proper design of new processing equipment and efficient use of new fibers on existing machines require an understanding of the dynamic interaction between textile materials and textile processes. During processing, textile fibers are subjected to varying applied stresses and strains caused by machine-material interactions.

This paper presents studies made of the interaction which takes place in certain high-speed textile processes at points of

machine fiber contact. Specific actions of weaving and sewing have been analyzed.

Management

Some Attitude and Personality Characteristics of Engineers in Industry..59—A-247... By Richard Renck, The University of Chicago, Chicago, Ill. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The introduction of large numbers of professional people into industry is a development unique to modern America. Many of the problems which the engineer and the scientist find in working for an industrial employer—and which the employer finds in supervising professional people—stem from the fact that these people bring with them to their first and every subsequent job a technique, a training, and a kind of experience which can be obtained only outside of industry.

Thus they have a status and a role to play in industry which are different from the status and role of those personnel whose training and techniques are largely acquired within industry. Rather extensive research on the subject shows that there is considerable consistency in the attitudes of engineers toward management, their profession, themselves, and other kinds of employees.

For high-status employees, engineers' attitudes about the work situation are considerably less favorable than might be expected. Most engineering groups evidence frustration and generalized dissatisfaction when given the opportunity to express their opinions and feelings anonymously.

Instruments and Regulators

The Response of a Pressure-Sensing System..59—A-289... By R. P. Benedict, Assoc. Mem. ASME, Westinghouse Electric Corporation, Lester, Pa. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959)

A first-order, first-degree, linear expression is developed to describe the transient behavior of a practical pressure-sensing system. The development is in terms of usual fluid-flow parameters. An experiment is described whereby the transient behavior is determined for a variety of pressure-sensing systems.

Experimental uncertainties are determined. Comparisons are drawn between several published expressions, the proposed linear expression, and the experimental data reported herein to indicate the validity of the proposed expression. A selected bibliography of related work is given.

Dynamics of Heat Exchangers and Their Models..59—A-117... By Herman Thal-Larsen, Mem. ASME, University of California, Berkeley, Calif. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

The author rejects, momentarily, actual experimentation with real heat exchangers for logical cogitation and arm-chair experiments. Observed as mental images or models, these heat exchangers reveal their basic characteristics —characteristics that will be partially obscured in an actual experiment by secondary effects inherent in the equipment. These basic characteristics, once perceived, may be used to correlate by means of frequency-response diagrams many results, heretofore diverse and seemingly unrelated, that have been reported in the literature.

Included among such results are not only the dynamics of various types of heat exchangers but also the thermal dynamic interaction between fluids and the confining pipe used for their transport. In addition, the author warns that all too frequently the use of the average temperature in heat-exchanger dynamics is based on faulty logic.

A Performance Criterion for Linear Systems..59—A-290... By D. W. Batteau, United Research Inc., Cambridge, Mass. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The input and output signals of a linear system are considered as two infinite dimensioned vectors. Orthonormal transformations of these time vectors preserve length of both as well as the length of the difference vector or error signal.

The system is then evaluated in terms of the Fourier transform of a colored random input and the Fourier transform of the system. The integral of the mean error squared is shown to be the square of the length of the error vector.

The relative effects of damping ratio and bandwidth on the magnitude squared of error vector is then investigated and bandwidth shown to be the principal controlling factor.

Precise Measurement of Clothes Insulation During Controlled Operation of the Human..59—A-197... By A. S. Iberall, Mem. ASME, Rand Development Corporation, Cleveland, Ohio. 1959 ASME Annual Meeting paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

It has been demonstrated that it is possible to measure the resistance of clothing as an ohmic relation among time-averaged equilibrium values of the flux of power (metabolism) and the potential difference between average skin temperature and ambient temperature.

Specifically, this has been demonstrated on the human in what has been referred to as the comfort mode of operation of the human system. In this mode of operation, the metabolic level of activity is changed by signaling command to attempt to maintain a specific control level of the average skin temperature.

With control attempted to approximately 0.1 deg C in temperature, sufficient accuracy has been achieved to resolve 1 or 2 per cent difference in clothes resistance. The dynamic input-output data obtained during clothes measurements are presented.

Diaphragm Actuated Control Valve Terminology..59—A-322... By the Subcommittee on Control Valve Terminology of the ASME-IRD Terminology Committee. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The Subcommittee on Control Valve Terminology of the ASME-IRD Terminology Committee was formed in 1956 to recommend a standard terminology for control valve parts and functions.

The present report prepared by the committee applies to the physical and operating characteristics of diaphragm-actuated, rising-plug types of control valves suitable for use as final control elements in automatic control systems.

Terminology presented is the result of surveys of technical papers, manufacturers' literature, and users' specification. Terms have been selected on the basis of preferred current usage and clarity. New terms have been avoided except where existing terms are inadequate or would result in ambiguity.

Aviation

A Note of the Calculation of the Strength of Specimens Containing Fatigue Cracks ..59—A-235... By A. J. McEvily, Jr., Walter Illg, and H. F. Hardrath, National Aeronautics and Space Administration, Langley Field, Va. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A recent paper by Frisch (see *Trans. ASME*, vol. 80, 1958, p. 921) dealing with effect of fatigue cracks on static strength is discussed. Certain errors involved in Frisch's paper are pointed out, and his conclusions regarding the applicability of a stress-concentration method in determining static strength are questioned.

Computations based on the stress-concentration method are shown to be in reasonable agreement with experimental data for a variety of ferrous and nonferrous alloys.

It is considered that the stress-concentration approach provides a general-

ized method for computing fracture strengths which has been checked for some materials and which can be easily extended to other material of interest.

Elimination of Noise in the Heat Exchanger of a Supersonic Wind Tunnel..59—A-232...By R. R. Godman, NASA, Lewis Research Center, Cleveland, Ohio, and Samuel Stein, Lewis Research Center, Cleveland, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

This paper shows how a serious noise problem created by the addition of a heat exchanger to a wind tunnel is solved.

The NASA Lewis Research Center 8 × 6-ft supersonic wind tunnel operates by taking air from the atmosphere through a drier bed to the compressor and wind-tunnel test section. The air is then discharged through a diffuser and muffler back to the atmosphere. The tunnel running time was limited to the water-collecting capacity of the drier bed. To remove this limitation, the tunnel circuit was fitted with a large tube-and-fin heat exchanger bank to remove the excess heat from the air stream.

During initial operation, intense noise and vibrations were generated by the heat exchanger. The frequency was established by the shedding of the von Karman vortexes off the tubes in the cooler bank. The noise source was amplified by the coexistence of a broad-band transverse, "organ-pipe-type resonance" off the flat heat-exchanger boundaries and by various vibrations of the structural components.

To eliminate the noise problem, means were sought to increase the natural organ-pipe frequency and to detune the organ-pipe resonance throughout the cooler. Noise determination and cooler modification to reduce the noise level are described.

Optimum Tolerances of Sheet Materials for Flight Vehicles..59—A-70...By G. A. Hoffman, The Rand Corporation, Santa Monica, Calif. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1960).

Sheet design in flight-vehicle structures is governed by two factors—proper choice of a material with certain minimum properties, and specification of the configurations and gage thickness. In specifying tolerances of sheets there are conflicting alternatives: (*a*) A liberal tolerance reduces purchasing costs and speeds delivery of the desired sheets; (*b*) a tight tolerance raises costs but helps to reduce extraneous weight.

This study develops a criterion by which the problem of tolerance specification can be solved for a variety of sheet materials for use in flight vehicles. The results indicate a significant disparity between present industry practices and the apparent optimum tolerances. These tolerances are listed as possible target requirements for rolling programs of new and future metals.

Supersonic-Wind-Tunnel Air-Drying-System Design..59—A-161...By T. W. Macios, Sverdrup and Parcel Engineering Company, St. Louis, Mo. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1960).

Space travel can never become a reality until existing high-speed and temperature problems are overcome. One of the most essential methods of testing existing problems known today is the wind tunnel. Air-drying system design for the supersonic wind tunnel entails many difficulties and presents one of the more critical barriers that must be overcome.

This paper provides criteria for air-drying-system design, discussing condensation and adsorption drying in terms of their characteristics, performance, and application. The method of selection is evaluated in terms of desired performance, adaptability, required reactivation, initial and operating cost.

Structural Weight Approximation for a Bell-Nozzle Divergent Section..59—A-69...By G. D. Brewer, Ramo-Wooldridge Corporation, Los Angeles, Calif.; and E. Levin, Assoc. Mem. ASME, The Rand Corporation, Santa Monica, Calif. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1960).

In the preliminary design of missile systems it is necessary to consider the weight of the individual components which comprise the missile. The usual procedure in weight approximation is to consider that an article is composed of small regular-shaped bits, each of whose weights is easily found and whose sum approximates the weight of the total article.

When the component is such an irregular shape that a simple approximation cannot be made, or where the number of digital operations is excessive, the estimation of its weight becomes a tedious procedure. In this report, a method is derived for approximating the structural weight of such an article, namely, the divergent section of a bell-shaped nozzle for a rocket motor.

Applied Mechanics

On the Indeterminateness of the Boundary Conditions for the Mixing of Two Parallel Streams..59—A-68...By K. T. Yen, Rensselaer Polytechnic Institute, Troy, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1960).

Results obtained from a study of the indeterminateness of the boundary conditions for laminar "free" mixing of two parallel streams under constant pressure are presented in this paper.

A method is given for the determination of the interface velocity, the location of the interface in the mixing region, and the transverse force acting on the dividing wall as a consequence of the mixing.

Based on available numerical data, calculations have been made for two free-stream velocity ratios, 0.5 and 0.

In practice, free mixing may be difficult to achieve.

It is shown that values of interface velocity obtained here differ appreciably from those obtained using other proposed boundary conditions (the third condition).

In addition, for a free-stream velocity ratio of 0.5 the interface deflects toward the higher velocity stream, while for a zero free-stream velocity ratio it deflects toward the zero (lower) velocity stream.

Mechanics of the Sheet-Bending Process ..59—A-35...By B. W. Shaffer, Mem. ASME, New York University, New York, N. Y.; and E. E. Ungar, Assoc. Mem. ASME, Bolt, Beranek, and Newman, Inc., Cambridge, Mass. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1960).

Two sets of expressions are obtained for residual stresses and deformations resulting from bending processes in which initially flat sheets are permanently deformed to sheets having finite radii of curvature.

One of these sets applies for sheets whose concave surfaces have radii of curvature under loads which are greater than 0.84 times the sheet thickness, and is associated with a residual plastic zone in the interior of the sheet.

The other set applies whenever the afore-mentioned radii of curvature are less than 0.84 times the sheet thickness, and is associated with residual plastic zones in the bar interior and near the concave boundary of the sheet.

Relaxation of a Cylinder on a Rigid Shaft..59—A-31...By E. A. Davis, Mem. ASME, Westinghouse Electric Corporation, Pittsburgh, Pa. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to Oct. 1, 1960).

In a previous paper (see *Trans. ASME*, vol. 74, 1952, pp. 381-385) the author

attempted to solve the problem of relaxation in a state of combined stress. At that time the only solution obtained was that for an ideal viscoelastic material. The stress distributions, according to that solution, were the original elastic distributions multiplied by a decaying function of the time.

In the present paper an attempt is made to extend the problem to a more realistic material where the plastic strain rates are proportional to the nth power of the stresses. The present problem of a shrink-fit cylinder on a rigid shaft differs from that of the rolled-in tube only in the boundary conditions.

A solution to the plane-stress problem, or the relaxation of a thin disk on a rigid shaft, has still not been obtained. The general problem of plane strain with any arbitrary value of Poisson's ratio also remains unsolved. It has been possible, however, to describe the behavior of the incompressible cylinder under the condition of constant total tangential strain at the bore.

On the Plastic Behavior of Rotating Cylinders..59—A-65... By F. P. J. Rimrott, Assoc. Mem. ASME, Ecole Polytechnique, Montreal, P. Q., Canada. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

Equations for strain and stress distribution in hollow rotating cylinders are developed.

The deformations are considered to be of such magnitude that the use of finite-strain theory is necessary.

It is assumed that the relationship of true stress to true strain can be represented by a power relation.

The three possible modes of plastic failure, namely, instability, cleavage, and shear fracture, are also discussed.

Shear Buckling of Bars..59—A-91.. By G. Herrmann, Mem. ASME, Columbia University New York, N. Y.; and A. E. Armenakas, Cooper Union for the Advancement of Science and Art, New York, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

It is shown that a perfectly straight bar, subjected to a state of uniform shear stress, will buckle, in a manner similar to a column under compression, if the shear stress exceeds a certain critical value.

The buckling equations are obtained by the Newtonian approach, and also by the application of the principle of minimum potential energy.

In order to provide additional insight into this buckling mechanism, a simple model is introduced and analyzed.

Effect of Shear Deformations on the Bending of Rectangular Plates..59—A-60... By V. L. Salerno, Mem. ASME, and M. A. Goldberg, Grumman Aircraft Engineering Corporation, Bethpage, L. I., N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

The three partial differential equations derived by Dr. E. Reissner have been reduced to a fourth-order partial differential equation resembling that of the classical plate theory and to a second-order differential equation for determining a stress function.

The general solution for the two partial differential equations has been applied to a simply supported plate with a constant load p and to a plate with two opposite edges simply supported and the other two edges free.

Numerical calculations have been made for the simply supported plate and the results compared with those of classical theory.

The calculations for a wide range of parameters indicate that the deviation is small.

ASME TRANSACTIONS

The March, 1960, issues of the Transactions of the ASME—*Journal of Applied Mechanics* and *Journal of Basic Engineering* (available at $1.50 per copy to ASME Members; $3 to nonmembers)—contain the following:

Journal of APPLIED MECHANICS

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TECHNICAL PAPERS

1 A Theory of Lubrication With Turbulent Flow and Its Application to Slider Bearings, L. N. Tao. (59—A-26)

5 Effect of the Wall on Two-Phase Turbulent Motion, S. L. Soo and C. L. Tien. (59—APMW-18)

16 The Melting of Finite Slabs, T. R. Goodman and J. J. Shea. (59—APMW-11)

25 Heat-Exchanger Tube-Sheet Design—3. U-Tube and Bayonet-Tube Sheets, Karl A. Gardner. (59—A-81)

34 Mechanics of the Sheet-Bending Process, B. W. Shaffer and E. E. Ungar. (59—A-35)

41 Relaxation of a Cylinder on a Rigid Shaft, E. A. Davis. (59—A-31)

45 Strain-Hardening Solutions to Axisymmetric Disks and Tubes, Nicholas Perrone. (59—A-29)

54 Effect of Shear Deformations on the Bending of Rectangular Plates, V. L. Salerno and M. A. Goldberg. (59—A-66)

59 Plastic Stress Concentration at a Circular Hole in an Infinite Sheet Subjected to Equal Biaxial Tension, Bernard Budiansky and O. L. Mangasarian. (59—APMW-16)

65 Stresses in the Plastic Range Around a Normally Loaded Circular Hole in an Infinite Sheet, O. L. Mangasarian. (59—A-130)

74 On a Dynamical Saint Venant Principle, B. A. Boley. (59—A-61)

79 Correlation of Theoretical and Photothermoelastic Results on Thermal Stresses in Idealized Wing Structures, Herbert Tramposch and George Gerard. (59—A-36)

87 Stresses in a Circular Cylinder Having an Infinite Row of Spherical Cavities Under Tension, Akira Atsumi. (59—APMW-9)

93 Transient Thermal Stresses in a Semi-Infinite Slab, W. Jaunzemis and E. Sternberg. (59—A-63)

104 On Stress-Strain Relations and Strain-Energy Expressions in the Theory of Thin Elastic Shells, J. K. Knowles and Eric Reissner. (59—APMW-13)

107 On the Effect of Shear on Plastic Deformation of Beams Under Transverse Impact Loading, B. Karunes and E. T. Onat. (59—APMW-7)

111 The Half-Space Under Pressure Distributed Over an Elliptical Portion of Its Plane Boundary, H. Deresiewicz. (59—A-17)

120 Earth Motion Beneath a Prescribed Boundary Displacement, R. C. Geldmacher, J. W. Dunkin, and R. L. Anderson. (59—A-3)

125 On the Elastic Bending of Columns Due to Dynamic Axial Forces Including Effects of Axial Inertia, Eugene Sevin. (59—A-25)

132 Dominance of Shear Stresses in Early Stages of Impulsive Motion of Beams, H. H. Bleich and R. Shaw. (59—A-60)

139 The Elastic-Plastic Response of Thin Spherical Shells to Internal Blast Loading, W. E. Baker. (59—A-95)

145 Axially Symmetric Waves in Elastic Rods, R. D. Mindlin and H. D. McNiven. (59—APMW-2)

152 Vibrations and Waves in Elastic Bars of Rectangular Cross Section, R. D. Mindlin and E. A. Fox. (59—APMW-23)

159 Subharmonic Oscillations of a Pendulum, Richard Skalak and M. I. Yarymovych. (59—A-94)
165 Plane-Stress Unloading Waves Emanating From a Suddenly Punched Hole in a Stretched Elastic Plate, Julius Miklowitz. (59—A-46)
172 Plastic-Wave Propagation Effects in Transverse Impact of Membranes, B. Karunes and E. T. Onat. (59—A-128)
177 The Motion and Loading of a Hinged Ramp Which Supports a Sliding Mass, B. Saelman. (59—A-85)
182 An Analytical Method for Locating the Burmester Points for Five Infinitesimally Separated Positions of the Coupler Plane of a Four-Bar Mechanism, J. C. Wolford. (59—A-11)
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1 Cavitation Effect on the Discharge Coefficient of the Sharp-Edged Orifice Plate, by F. Numachi, M. Yamabe, and R. Ōba. (58—A-93)
12 Measurement of Oil-Film Thickness Between Disks by Electrical Conductivity, by S. I. El-Sisi and G. S. A. Shawki. (58—A-253)
19 Performance Characteristics of Lubricating Oil Film Between Rotating Disks, by S. I. El-Sisi and G. S. A. Shawki. (58—A-254)
29 The Measurement of Oil-Film Thickness in Gear Teeth, by I. O. MacConochie and A. Cameron. (58—A-142)
35 A New Approach to Linear Filtering and Prediction Problems, by R. E. Kalman (59—IRD-11)
46 Shannon's Theory and Feedback Systems, by S. S. L. Chang. (59—IRD-12)
51 Dynamic Response and Control of Multipass Heat Exchangers, by M. Masubuchi. (59—IRD-6)
66 Bang-Bang Versus Linear Control of a Second-Order Rate-Type Servomotor, by P. F. Meyfarth. (59—IRD-13)
73 The Design and Analysis of a Servovalve With Flow Feedback, by E. Bahniuk and S.-Y. Lee. (59—IRD-3)
81 A Thermocouple System for Measuring Turbine-Inlet Temperatures, by M. E. Ihnat and W. C. Hagel. (59—IRD-1)
87 Estimating the Roots of the Characteristic Determinant for Multicoupled Systems, by S. Lees, H. D. Felsenthal, and E. M. Goldberg. (59—IRD-2)
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155 Crossover Systems Between the Stages of Centrifugal Compressors, by G. O. Ellis. (59—Hyd-3)
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210 Unsteady Transfer of Momentum and Heat Between Concentric Cylinders, by C.-S. Yih. (59—Hyd-17)
217 Chamber Dimension Effects on Induced Flow and Frictional Resistance of Enclosed Rotating Disks, by J. W. Daily and R. E. Nece. (59—Hyd-9)
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COMMENTS ON PAPERS

Are Engineers Interested in Engineering?

To the Editor:

AT A RECENT meeting of Division Chairmen of an ASME Section, a discussion took place about meeting attendance. The usual reasons for this condition were bandied about until one chairman arose and said that a study of technical people in his organization had convinced him that there were just too many engineers who were not interested in engineering. Most were interested in their own specialty but not other facets of their profession.

Is this a condition confined only to engineers or is it a common finding with many professions? Can something be done about it?

I believe clergy from many denominations decry lack of attendance at religious services except on special holidays and unusual observances. Only recently has there been a drive organized to get businessmen interested in politics and this came about because it was evident lack of attention was causing great disservice to their vested interests. So the trait of complacent disinterest is one which affects many phases of our social and professional activities.

Certainly improved attendance can be provided if a meeting topic directly hits the major interests of a majority of the members, but no program chairman can guarantee to provide such a desirable result over the year. It will become necessary to get more engineers interested in engineering before complete success with a diversified program can be realized, just as it will take more people interested in religion to fill our churches.

Are we one of those who will not attend a baseball or football game because there is no interest in either team? Are there only a comparatively few people who like a sport or event so much they take it in irrespective of personal involvement with the contestants? Does this point up the fact that constitutionally many of us are not fundamentally sport enthusiasts, formal religionists, or professional engineers? The true professional must be one able to enjoy many aspects of an event or an occurrence which escapes the attention of those with less discernment, or training in perception.

It must therefore follow, if the engineer is not interested in engineering, that a great many engineers never acquire talents which make it possible for them to perceive the common thread of engineering endeavor, nor appreciate the broadening influence of the diverse approaches of others upon their own specific and limited fields. Without this broader appreciation, I am sure we exist at a level far below our full capabilities.

But the greater evil is the example set the younger engineer by his senior or superior who neither sets a good example nor encourages a more comprehensive understanding of the engineering profession which is developed by attending the diverse meetings of the various divisions in ASME. In no other way can one obtain stimulation, acquire enthusiasm, new interests, and greater stature and satisfaction than among those who share a common professional life.

If engineers are a dull boring lot, just remember much of it is caused by their restricted activities. We must influence the younger engineer to be more discerning than we have been and, in fact, we can do a great deal to improve our older less flexible habits.

Every engineer should make a pledge to himself to attend at least one or more of his section-division meetings a month and bring along several younger associates to share the experience. It is important that this attendance be in divisions in which the engineer is not engaged so there is a break in routine. It is a sure bet that gradually an expanded respect and admiration would develop for the complex disciplines of our profession. If each is so obligated to participate, the engineer would gradually recognize this essential phase of his professional responsibilities. Are we too naive to expect that eventually all engineers would become interested in engineering and eager to advance it professionally!

S. R. Hirsch.[1]

[1] Assistant to vice-president—Engineering, Worthington Corporation, Harrison, N. J. Mem. ASME.

Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

Vibration Engineering

Vibration Engineering. A practical treatise on the balancing of engines, mechanical vibration, and vibration of isolation.

By W. Ker Wilson, Charles Griffin & Co., Ltd., London, England, 1959. Cloth, 7 × 9 ¾ in., preface tables, illus., worked examples, bibliography, selected list of British Patents, index, xii and 292 pp., 90s.0d, postage 1s.9d.

Reviewed by Charles E. Crede[1]

[1] Associate Professor of Mechanical Engineering, Division of Engineering, California Institute of Technology, Pasadena, Calif. Mem. ASME.

MANY readers will be pleased to find that this new book by a well-known author comes up to expectations in the detailed and comprehensive treatment of the subject that it covers. The author's previous treatise on torsional vibration reflects his extensive experience with internal-combustion engines; this reflection is continued in the new book.

Even though the title of the book suggests a broad subject matter, the content is limited to certain aspects of internal-combustion engines and vibration isolation. Approximately 25 per cent of the book is devoted to the former; it includes methods of determining natural frequencies of shafts carrying several rotors, and methods of calculating the vibration amplitudes of such shafts at both resonant and nonresonant conditions. This part of the book also includes a chapter on the nature and magnitude of the residual unbalance with various arrangements and numbers of cylinders, and considers the effect of firing order on crankshaft vibration.

The major part of the book is devoted to a detailed treatment of vibration isolation wherein the machine can be considered a rigid body supported on several springs and free to vibrate in any mode of vibration. The natural frequencies in coupled modes are considered in detail. The treatment of forced vibration is limited primarily to the single degree-of-freedom system with the excitation provided, alternatively, by the ground motion or by a force generated within the machine. It is pointed out that the results demonstrated by the single degree-of-freedom theory can be extrapolated effectively to the more complicated case with several degrees-of-freedom provided the necessary frequency relations are maintained in general. This part of the book also mentions the auxiliary mass damper and the effect of ground flexibility.

The mechanical properties of rubber springs are discussed prominently. Design data are given for pads and bushings arranged in a number of familiar and useful configurations. Of particular interest are the arrangements of rubber pads with their principal elastic axes inclined in such a manner as to decouple the natural modes of vibration of the isolated equipment.

That the book is not intended as a text is indicated not only by the specialized nature of the subject matter but also by the arrangement of material. For example, the first page includes three simultaneous equations of motion for the vibration of a crankshaft with three rotors. The second part of the book follows a similar pattern and includes on the third page a sixth-order frequency determinant for defining the natural frequency of a body on springs having six coupled modes of vibration. The natural frequency of a single degree-of-freedom system is defined by an equation that appears 100 pages later. Obviously it is presumed that the reader has sufficient familiarity with vibration theory to start at the advanced level of the first pages of the book.

The subject matter is at a practical level throughout, and in a style that is of maximum usefulness to the practicing engineer. Particular emphasis is given to numerical results, and to tabular methods of organizing calculations.

The notation is somewhat unusual and tends to detract from the readability of the book. For example, p is used for stiffness and q for force; rotational displacement about the x-axis is indicated by x. Tables of data are used extensively throughout the book, sometimes in preference to graphical presentations of data; in some instances, a graph would not only be desirable for pictorial reasons but would be more readily adapted to interpolation. This reviewer finds the large page size, approximately 7 by 10 in., somewhat cumbersome compared with the standard book size of approximately 6 by 9 in.

It is quite evident from the content and nature of the material that the book is directed primarily toward the design of rubber vibration isolators for internal-combustion engines. The subject matter is somewhat broader than this in some respects, particularly regarding the natural modes of vibration of a body on several springs. However, the examples are predominantly related to engines and essentially all information fits into this common pattern. For an engineer with problems in this category, the book is a comprehensive and detailed treatise. Those with broader interests will find choice bits of information not covered in equivalent detail elsewhere in the literature.

BOOKS RECEIVED IN LIBRARY

The Performance of Lubricating Oils
By H. H. Zuidema. Second Edition. 1959, Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. 205 p., $6^1/_4 \times 9^1/_4$ in., bound. $7. The performance characteristics of lubricating oils under various conditions are summarized and evaluated. Entire chapters are included on lubrication processes, rheology, oxidation, bearing corrosion, sludge and lacquer deposition, emulsification and foaming, and manufacturing methods. Subjects new to the edition include multigrade motor oils, fretting wear, and paper chromatography.

Petroleum Refinery Manual
By Henry M. Noel 1959, Reinhold Publishing Corp., New York, N. Y. 182 p., $7 \times 10^1/_4$ in., bound. $7.95. An integrated picture of refinery design and construction is presented which includes engineering aspects such as estimating, scheduling, and mechanical design; shop fabrication in relation to tanks, piping, pumps, etc.; and field construction. Examples of finished work are described that furnish useful standards of comparison for new work. In addition descriptions and diagrams of modern refining processes are given with figures covering capital investment, operating manpower, and operating costs.

Plansee Proceedings, 1958 (High-Melting Metals)
Edited by F. Benesovsky. 1959, Springer-Verlag, Vienna, Austria. 465 p., $6^1/_4 \times 9^1/_4$ in., bound. $11.65. This, the third Plansee Seminar, is concerned with the high-melting transition metals and their alloys. The first part deals with theoretical questions, such as the mechanism of sintering and the structure of high-melting metals, the second with tungsten and tungsten alloys, and the third with molybdenum and molybdenum alloys. Tantalum and niobium, as well as rarer metals and alloys are treated in part four and five, while the final section includes papers on metal—metal oxide materials.

Plant Engineering Handbook
Edited by William Staniar. Second Edition. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. Various pagings, $6^1/_4 \times 9^1/_4$ in., bound. $23.50. This handbook covers the various aspects of plant organization, design, construction, operation, and maintenance from the viewpoint of efficiency and economy. In this edition new sections cover advances in standardization of engineering practice, industrial building heating, automation, synthetic lubricants, industrial electronics, as well as other areas. In addition, the sections retained from the previous edition have been extensively revised.

Process Equipment Design: Vessel Design
By Lloyd E. Brownell and Edwin H. Young. 1959, John Wiley & Sons, Inc., New York, N. Y. 408 p., $8^1/_2 \times 1/_4$ in., bound. $18. The basic concepts, industrial practices, and theoretical relationships useful in the design of processing equipment are presented with particular reference to pressure vessels. Beginning with a review of elementary theories of mechanics and strength of materials, the material covered ranges from simple vessels for low-pressure service to thick-walled vessels for high-pressure applications. Advanced theory is developed as needed and is integrated with design practice.

Progress in Cryogenics, Vol. 1
Edited by K. Mendelssehn. 1959, Academic Press, Inc., New York, N. Y. 259 p., $6^1/_4 \times 10$ in., bound. $11. A collection of papers

covering the production, maintenance, and measurement of low temperatures and their practical application to the techniques used in basic research. Topics discussed include superconductivity circuits, thermoelectric cooling, distillation at low temperatures, measurement of mechanical properties of metals at low temperatures, frozen free radicals, low-temperature calorimetry, the determination of specific heats by the temperature-wave method, and ultrasonic attenuation in metals at low temperatures.

Progress in Nuclear Energy (Series I, Physics and Mathematics, Vol. 3.)
Edited by Donald J. Hughes. 1959, Pergamon Press, New York, N. Y. 403 p., $6^1/_4 \times 9^1/_4$ in., bound. $15. A selection of papers presented at the second UN Conference on the Peaceful Uses of Atomic Energy. Among the topics discussed are the slow neutron fission cross sections of the common fissile nuclides, radiochemical methods applied to the determination of cross sections of reactor interest, fast neutron scattering and capture by atomic nuclei, radiative capture of fast neutrons, mass distributions in thermal and resonance fission, and the use of the pile oscillator in thermal reactor problems. A number of papers are devoted to the experimental and theoretical aspects of the process of neutron thermalization and its bearing on the neutron energy spectra in reactors.

Property Measurements at High Temperatures
By W. D. Kingery. 1959, John Wiley & Sons, Inc., New York, N. Y. 416 p., $7^1/_2 \times 10^1/_2$ in., bound. $16.50. Intended for the reader who is concerned with the development or application of materials at unusually high temperatures, this volume concentrates on the factors affecting the properties of materials and their measurement at temperatures exceeding 1400 C. The various important high-temperature properties are discussed including heat conduction and radiation, density and thermal expansion, strength, elasticity of solids, viscosity, electrical and magnetic properties, and surface energy. The most suitable method for determining each property at high temperatures is examined.

Radiation Hygiene Handbook
Edited by Hanson Blatz. 1959, McGraw-Hill Book Co., Inc. New York, N. Y. Various pagings, $6^1/_4 \times 9^1/_4$ in., bound. $27.50. The industrial, medical, and research uses of radiation and atomic energy are covered with specific reference to the field of health physics, industrial hygiene, and sanitary engineering. Essential information is provided on exposure standards, sources of radiation, waste disposal, air and water-pollution control, physiological effects of radiation, along with tables and general data. Description of natural and man-made sources of radiation are presented in such a way as to aid in classifying a particular hygiene problem.

Rubber Red Book, 1959
Twelfth Edition. Published by Rubber Age, New York, N. Y. 852 p., $8^1/_4 \times 11^1/_4$ in., paper. $15. Directory information is given for rubber manufacturers in the U. S. and Canada; rubber machinery and equipment; rubber chemicals and compounding materials; natural, synthetic, and reclaimed rubber; latex and related materials; and many other aspects of the rubber industry.

The Science of Mechanics in the Middle Ages
By Marshall Claggett. 1959, The University of Wisconsin Press, Madison, Wis. 711 p., $6^3/_4 \times 10$ in., bound. $8. This volume is a guide and source book for the study of the development of mechanics in the period before Galileo. It includes both extensive commentary and numerous texts, with the purpose of offering a documentary analysis of the criticism and modification of Aristotelian mechanics that took place from the thirteenth to the fifteenth century. In the course of his study, the author establishes the importance of the medieval studies as a significant link between Aristotelian and Newtonian concepts.

Servomechanism Fundamentals
By Ben Zeines. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 257 p., $6 \times 9^1/_4$ in., bound. $5.50. The fundamentals underlying serve systems and data-transmission systems are presented in a nonmathematical fashion. The author discusses elementary forms of control systems, serve systems, synchros, servo elements, and electronic and magnetic amplifiers. In addition, direct and alternating-current servomotors are discussed in detail, and performance improvers and methods of measurement are included. A large number of diagrams, closely integrated and correlated with the textual matter is provided.

Space Technology
Edited by Howard S. Seifert. 1959, John Wiley & Sons, Inc., New York, N. Y. Various pagings, $6 \times 9^1/_4$ in., bound. $22.59. A thorough exposition is given of the fundamental physical principles of very long-range ballistic vehicles, stressing the quantitative relations that are most useful for space flight. In addition to a particularly thorough discussion of ballistics and flight dynamics, coverage is given to propulsion, communications and guidance, man in space, and the scientific uses of space. The 500 selected references given provide a guide to the significant literature in this field.

Steam Power Plants
By Charles Donald Swift. 1959, McGraw-Hill Book Co., New York, N. Y. 491 p., $6^1/_4 \times 9^1/_4$ in., bound. $11.50. All classes of steam boilers and steam-electric plants from pressures above low-pressure heating installations up to supercritical high-temperature installations are covered. The mode of operation of the various power-plant apparatus and how they are tied together into a complete operating power plant is described. Instruments, safety devices, and electric equipment are also discussed, as are the factors that must be considered in achieving economical power production.

Symposium on Bulk Quantity Measurement
Published 1959 as Special Technical Publication No. 249 by the American Society for Testing Materials, Philadelphia, Pa. 50 p., 6×9 in., paper. $2.25. Papers discussing the use of bulk measurement devices in the petroleum industry. These include hand gages, automatic tank gages, temperature equipment, and positive displacement meters.

Symposium on Bulk Sampling, 1958
Published 1959 as Special Technical Publication No. 242 by the American Society for Testing Materials, Philadelphia, Pa. 60 p., $6^1/_4 \times 9^1/_4$ in., bound. $2.25. Among the topics discussed are measurement-error factors in bulk sampling, the problems faced in sampling a particular class of bulk material, and the sampling of coal and similar materials.

Symposium on Instrumentation in Atmospheric Analysis
Published 1959 as Special Technical Publication No. 250 by the American Society for Testing Materials, Philadelphia, Pa. 57 p., $6^1/_4 \times 9^1/_4$ in., bound, $2.25. It has been recognized that continuous analysis and recording of pollutants is necessary for an adequate appraisal of the hazards of pollutants and the effectiveness of any remedial measures taken. With this in mind, the papers included deal with the development of instrumentation to analyze the atmosphere for many compounds and classes of compounds.

Uranium Production Technology
By Charles D. Harrington and Archie E. Ruele. 1959, D. Van Nostrand Co., Inc., Princeton, N. J. 579 p., $6^1/_4 \times 9^1/_4$ in., bound. $17.50. The technology used in producing high-purity uranium metal and compounds is discussed. The major portion of the book deals with present-day production techniques and the ensuing fabrication methods of rolling, extruding, forging, and machining. In addition, there are separate chapters on the chemistry and metallurgy of uranium, uranium alloys, producing uranium hexafluoride, producing enriched compounds, new technology, and health-hazard control.

Warmofen für Walzwerke und Schmieden
Edited by Z. Wusatowski. 1959, Verlag Technik, Berlin, Germany. 612 p., $7 \times 9^3/_4$ in., bound. 43 DM. This collective work, originally published in Polish, deals with the design and operation of heating furnaces for rolling mills and forges. Both fuel-fired and electrical furnaces are covered, and the book also includes basic combustion theory, specialized aspects, and numerical examples of calculations. Extensively illustrated, the book emphasizes the practical side of the subject.

Nuclear Propulsion and Engineering for Engineers
By Demetrios G. Samaras. 1955, Technical Chamber of Greece, Athens, Greece. 710 p., $7 \times 9^3/_4$ in., bound. $12.50. The principles of nuclear energy and their application to aircraft propulsion are presented. The author discusses radioactivity associated with energy release; nuclear reactions as a source of energy release; neutrons as triggers of nuclear energy release; energy release characteristics of fission; neutron dynamics in propulsion reactors; steady operation of thermal neutron homogenous reaction and other type of reactors; unsteady reactor operation and control; and nuclear energy extraction and transformation. Since the use of materials and their modes of failure are of considerable importance, the author included a considerable amount of information on high-temperature materials, heat transfer, creep, thermal fatigue, corrosion, oxidation, and thermal shock. Although only unclassified or declassified data are used, much useful information is included.

LIBRARY SERVICES

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Applied Mechanics: Dynamics

By G. W. Housner and D. E. Hudson. Second Edition. 1959, D. Van Nostrand Company, Inc., Princeton, N. J. 392 p., 6 × 9¼ in., bound. $5.25. Emphasis is placed on particle and rigid-body dynamics although some of the other aspects of the subject are included. This edition contains rewritten sections on dimensional analysis and impact problems, expanded coverage of variable mass systems of particles, and a more complete development of the general momentum equations for systems of particles. In addition, the discussion of rotation about a fixed point and gyroscopic motion has been extended to more complex systems such as the stability of rolling motion, and a general treatment of the problem of small oscillations of a conservative system has been added.

Applied Solar Energy Research

Second Edition. Published 1959 by the Association for Applied Solar Energy Research, Phoenix, Ariz. 275 p., 8½ × 11 in., bound. $7.50. The work of laboratories and of individuals actively engaged in solar energy research is described, and a bibliographical survey is made of the field. Arrangement of the bibliography is by broad subject divisions which include such aspects as solar radiation and its effects, and the use of solar energy as heat-low temperature conversion, as heat-high temperature conversion, and as light.

Appraisal and Valuation Manual

Published 1959 by The American Society of Appraisers, Washington, D. C. 525 p., 6 × 9 in., bound. $15. Topics discussed in this manual cover a broad area of interest, ranging from the valuation of Currier and Ives prints and early American pewter to the appraisal of large-scale housing projects and the Empire State Building. Included are articles on tax equalization, capitalization rates, buyer motivations, depreciation, obsolescence, ad valorem assessment, structural costs, accounting concepts, condemnation, backward valuation, specialty financing, and other topics.

Automation Today and Tomorrow

By L. Landon Goodman. 1959, Essential Books, Fairlawn, N. J. 158 p., 5¾ × 8¾ in., bound. $7.20. The field of automation is surveyed and some of its important aspects are described. These include sales and distribution, building design, computer control of processes, instrumentation in the process industries, processing methods and automatic assembly, industrial finishing, and inspection and testing. In addition, automation in specific industries is discussed, and an extensive bibliography is provided which includes references to books and articles covering many of the advance in automation.

Design of Industrial Exhaust Systems

By J. L. Alden. Third Edition. 1959, the Industrial Press, New York, N. Y. 243 p., 6¼ × 9¼ in., bound. $6. How to design, build, or buy industrial exhaust systems that will adequately and economically perform the functions required by law is described. Extensive revisions and additions have been made in this edition which discusses flow of fluids; hoods for dust control; hoods for fume, smoke, and vapor control; air flow through hoods; duct resistance and design; dust separators; low-pressure conveyers; centrifugal and axial flow fans; structural details and system planning; and field measurements.

The Diesel Engine

By L. V. Armstrong and J. B. Hartman, 1959, The Macmillan Company, New York, N. Y. 360 p., 5¾ × 8½ in., bound. $8.75. Based on the practical experience of the authors, this volume provides a survey of diesel engine operation and design. It begins with a discussion of petroleum and refining methods and of diesel-fuel combustion. This is followed by the effect of the forces released by combustion on the moving parts of the engine and on the static or restraining parts of the engines. There is then a treatment of "parasitic engine parts," and a concluding section on economics, including power application. A feature of the volume is the introduction, at appropriate points, of a "basic design problem" which illustrates the theory with which it is associated.

La Fatigue des Metaux

By R. Cazaud. Fourth Edition. 1959, Dunod, Paris. 574 p. 6¼ × 10 in., bound. 6900 fr. Discusses the characteristics of fatigue failures, theories relating to the mechanism of metal-fatigue, methods for carrying out fatigue tests, and the endurance limits of metals and alloys. In addition, there is detailed consideration of the various factors that affect fatigue such as the dimensions and shape of the piece, nature of the surface, temperature, corrosion, and cavitation. Concluding sections deal with the endurance of joints and improving the endurance of machine parts.

Friction in Textiles

By H. G. Howell and others. 1959, Interscience Publishers, Inc., New York, N. Y. 263 p., 5¾ × 8¾ in., bound. $6.75. Beginning with a discussion of the theories of friction and lubrication, in which an attempt is made to emphasize the physical picture as it exists today, the authors continue with the practical problems occasioned by friction in textile processing. This is followed by a detailed review of the principal methods and technique used in measuring friction, yarn tension, and abrasion. An appendix gives typical values of the coefficient of friction under various conditions of test, and includes a bibliography where further experimental data can be found.

Gmelins Handbuch, Eighth Edition

Systems Nr. 5, Flour, Ergänzungsband. 1959. 258 p., 6¾ × 9¾ in., paper. $36.00. System Nr. 15, Silicium, Teil C. 1958. 501 p., 6¾ × 9¾ in., paper. $67.44. System Nr. 59, Eisen, Teil D, Ergänzungsband, Magnetische Werkstoffe. 580 p., 6¾ × 9¾ in., paper. $77.04. Published by Verlag Chemie, Weinheim, Germany. Three new volumes have been added to this extensive reference work:

Fluorine: A supplementary volume covering the literature from 1926 to 1949 covering the occurrence, production, physical properties, chemical reactions, and analytical determination of fluorine.

Silicon: An addition to the previous silicon volumes which deals specifically with the preparation, constitution, properties, and applications of the organosilicon compounds.

Magnetic materials: Essentially a supplement to the previous volumes on iron, this extensive treatment of the constitution and properties of ferromagnetic elements and alloys also supplements the cobalt, nickel, manganese, and chromium sections of the series. A large part is devoted to the oxide semiconductors.

High Speed Computing

By S. H. Hollingdale. 1959, The Macmillan Company, New York, N. Y. 244 p., 5¾ × 8¾ in., bound. $5. The subject of computing is approached from the point of view of the use, with particular emphasis on programming. Following an elementary introduction, two British computers, the EDSAC and the DEUCE, are considered in detail, and the problems of storage and "logical design" of computing circuits are discussed. The concluding portion is concerned with applications in science and research, The Monte Carlo method, control of industrial processes by computers, and the machine translation of languages.

Instationäre Wärmespannungen

By Heinz Parkus. 1959, Springer-Verlag, Vienna, Austria. 165 p., 6¼ × 9½ in., bound. $9.05. An analytical treatment of transient thermal stresses in elastic, viscoelastic, and elastoplastic bodies. The author covers the general principles of thermoelasticity; discusses heating and costing phenomena, moving heat sources, and dynamic influences; and provides detailed examples of several specific types of thermal stress or thermal shock under various conditions.

Instrumentation in Scientific Research

By Kurt S. Lion. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 324 p., 6¼ × 9½ in., bound. $9.50. A comparative study and analysis of electrical input transducers which stresses basic methods and systems used. Input transducers for mechanical, thermal, magnetic, and electric quantities, as well as for optical and nuclear radiation are discussed. The physical mechanisms involved in the operation of each transducer are described, as are the quantitative relationships between input and output, and the range of application. The limitations, the errors, and the response to environmental influences are also considered.

Machinery's Handbook

Edited by H. L. Horton and others. Sixteenth Edition. 1959, The Industrial Press, New York, N. Y. 2104 p., 4¾ × 7¼ in., bound. $11. Containing more than 200 pages of mechanical tables, rules, formulas, and general data, this volume deals with a wide variety of topics, among which are shafting, springs, bearings, gearing, splines, chains, screw thread systems, milling and grinding, machining various materials, properties of various metals, and measuring instruments and gaging methods.

The Magnetodynamics of Conducting Fluids

By Daniel Bershader. 1959, Stanford University Press, Stanford, Calif. 145 p., 6¼ × 9¼ in., bound, $4.50. Electromagnetic theory and fluid mechanics are combined from the continuum point of view in order to discuss the physical concepts and obtain results relating to the influence of magnetic fields on wave propagation, shock tube flows, subsonic and supersonic nozzle flows, and viscous boundary layers. Although the studies are largely analytical, some experimental results dealing with magnetohydrodynamic lift and with shock wave behavior have been added.

Metals for Nuclear Reactors

By W. A. Maxwell. 1959, American Society for Metals, Cleveland, Ohio. 117 p., 6¼ × 9¼ in., bound. $8. This basic introduction to the principles of nuclear metallurgy discusses physical principles, typical design and materials problems, effects of radiation, corrosion by liquid metals and aqueous solutions, fabricating techniques for reactor components, and testing methods.

Modern Trends in Documentation

Edited by Martha Boaz. 1959, Pergamon Press, New York, N. Y. 103 p., $6^1/_4 \times 9$ in., bound. $5. Papers surveying the field of information retrieval and documentation. They discuss the individual needs of libraries served by information retrieval systems, problems of locating information, mechanical translation by automatic computers and language data processing, automatic encoding and data retrieval by microfilm, magnacard, and minicard. The papers constitute the proceedings of a symposium at the University of Southern California, April, 1958.

More Studies in Early Petroleum History

By R. J. Forbes. 1959, W. S. Heinman, New York, N. Y. 199 p., $7^3/_4 \times 10^1/_2$ in., bound. $10. This volume which is an offshoot of the historical section of the Second World Petroleum Congress contains essays dealing with the little-known European petroleum industry which fluorished in the times of Drake and which rose against heavy competition of the cannel-coal, lignite, peat, and tar industries. The development of this industry is chronicled by abstracts from the original documents which are accompanied by a clarifying commentary.

Nomography

By A. S. Levens. Second Edition. 1959, John Wiley & Sons, Inc., New York, N. Y. 296 p., $6^1/_4 \times 9^1/_4$ in., bound. $8.50. A text that provides a working knowledge of the basic theory and construction of charts involving straight line scale curved scales, and combinations of the two. In this edition, new chapters are presented on circular nomograms, projective transformations, and the relationship between concurrency and alignment nomograms. In addition, there is a considerable expansion of the material included in the previous edition and a number of new problems and examples are introduced. An appendix includes 58 nomograms from various scientific fields.

Principles of Analog Computation

By G. W. Smith and R. C. Wood. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 234 p., $6^1/_4 \times 9^1/_4$ in., bound. $7.50. Designed for the user of analog computers, this volume presents those methods of analog computation which form the fundamental tools for the analyst working in the field. With primary emphasis on the types of problems that can be solved, such topics are discussed as problem planning and programming, simulation of linear systems, the use of diodes in analog computations, function relays, implicit-function techniques, and arbitrary function generators.

Principles of Mechanics

By J. L. Synge and B. A. Griffith. Third Edition. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 552 p., $6^1/_4 \times 9^1/_4$ in., bound. $9.50. Divided into three parts dealing with plane mechanics, mechanics in space, and general methods and relativity, this volume emphasizes basic principles and the fact that theoretical mechanics is based on mathematical models of things in the natural world. This new edition has been substantially enlarged and now devotes three chapters to the methods of Lagrange and Hamilton, including derivation of the equations, variational principles and the Hamilton-Jacobi equation, and the application of Langrangian methods to the theory of small oscillations.

Progress in Nuclear Energy (Metallurgy and Fuels, Vol. 2.)

Edited by H. M. Finniston and J. P. Howe. 1959, Pergamon Press, New York, N. Y. 653 p., $6^1/_4 \times 9^1/_4$ in., bound. $21. The present volume is divided into two parts. Part one is an account of the metallurgical development of the various materials of specific interest to nuclear energy. In this section, an attempt is made to report the experiences of various countries in respect to their development of particular fuel elements for a number of diverse reactor systems. Part two is concerned with solid-state physics and physical metallurgy.

Review of Metal Literature, 1958

Edited by Marjorie R. Hyslop. 1959, The American Society for Metals, Cleveland, Ohio. 1289 p., $6^1/_4 \times 9^1/_4$ in., bound $20. This volume includes brief abstracts of the published literature in the field of metals for the year 1958. The abstracts are designed to indicate the scope and content of the article rather than to be informative. Although the method of classifying these abstracts into subject subdivisions is based on the "ASM-SLA Metallurgical Literature Classification," a complete alphabetical subject index is also provided.

Rheology of Disperse Systems

Edited by C. C. Mill. 1959, Pergamon Press, New York, N. Y. 223 p., $5^1/_2 \times 8^3/_4$ in., bound. $9.50. The latest experimental and theoretical work in this field is covered in these papers which were presented at a conference sponsored by the British Society of Rheology. The papers included fall into two categories. In the first the dispersions discussed are dilute or composed of noninteracting particles, and the experiments are designed to test hydrodynamic theory. In the second concentrated suspensions, used industrially in various forms of surface coating, are studied with the object of relating performance to rheological properties.

Symposium on Particle Size Measurement

Published 1959 as Special Technical Publication No. 234 by the American Society for Testing Materials, Philadelphia, Pa. 310 p., $6^1/_4 \times 9^1/_4$ in., bound. $6.25. Representing current thinking in the field of particle size measurement, many aspects of this type of measurement are discussed, including sieves, mechanical methods of separation, electronic methods of measuring, and photoelectric procedure.

Tool Engineers Handbook

Second Edition. Published 1959 by the McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, $6^1/_2 \times 9^3/_4$ in., bound. $19.50. A comprehensive source of information on the design, fabrication, maintenance, and utilization of tools, prepared under the supervision of the American Society of Tool Engineers. Among the varied aspects discussed are product design and cost estimating; the economical selection of machines, processes, and tools; and the analysis and improvement of setups and operations. This new edition brings the information in the handbook up-to-date, and includes such recent aspects as automation, numerical control, electromachining, trepanning, shell molding, learning curves, etc.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting Jan. 15, 1960, and approved by the board on March 3, 1960.)

Case 1272N-1

(Reopened) (Special Ruling)

Containment and Intermediate Containment Vessels

In the Reply add new Par. (5) to read:

(5) *Allowable Stresses for Containment Vessels and Intermediate Containment Vessels:* In lieu of the rise in pressure permitted by Par. UG-125(c) for vessels provided with pressure relief devices, containment vessels and intermediate containment vessels not provided with pressure relief devices as permitted in Item (2) of the Reply to Case 1271N may be designed in accordance with the formulas and rules of Section VIII, as modified by this Case, with allowable stress values 1.1 times those given in Table UCS-23, provided the following requirements are met:

(a) The requirements of Par. (1) of this Case are met.

(b) The design pressure and temperature are based on the maximum values which will be attained during the most severe credible incident, irrespective of the duration of the pressure, and provision shall be made for any vacuum conditions that may occur.

(c) For pressures and temperatures imposed during normal operation of the plant, the formulas of Section VIII are used with allowable stress values the same as those given in Table UCS-23.

(d) Hydrostatic tests made in accordance with Par. UG-99 are made at 1.35 times the design pressure at test temperature, and pneumatic tests made in accordance with Par. UG-100 are made at 1.15 times the design pressure and test temperature.

(e) Reinforcement of openings designed in accordance with the rules of Section VIII are based on shell thicknesses determined from the present stress values given in Table UCS-23 using the pressure and temperature from (b) above.

Case 1273N-1

(Reopened) (Special Ruling)

Nuclear Reactor Vessels and Primary Vessels

In the Reply add a new Par. (10) to read:

In power reactor systems of the pressurized water or boiling water types using suitably clad solid fuel elements, compliance with the special rules of this Case is not required in the construction of those portions of secondary loops of the system that are not in direct contact with the primary coolant during normal operation.

Case 1274N-1

(Reopened) (Special Ruling)

Nuclear Reactor Vessels and Primary Vessels

In the Reply add Item (2) to read:

Steel castings conforming to ASTM Specification A 356-58T, Grade 10, and complying with the specified additional requirements below may be used with a casting quality factor of 100% in the construction of nuclear vessels for temperatures between −20 and 650 F.

(a) 1 Each casting shall be subjected to 100% visual and magnetic particle inspection of all surfaces after heat-treatment. Magnetic particle inspection required by the specification shall not show types of discontinuity greater than Degree 1 of Types II, III, and IV of ASTM Designation: E 125-56T. All Type I indications shall be removed. The inspection of technique shall be in accordance with ASTM Designation: E 109-57T.

2 All parts of castings up to 12 inches in thickness shall be subjected to complete radiographic inspection and the radiographs shall conform to the requirements of ASTM Specification E 71-52. "Industrial Radiographic Standards for Steel Castings," Class 2.

3 All parts of castings in excess of 12 inches in thickness which are not radiographed shall be ultrasonically examined in accordance with the procedures given in ASTM E 114-55T. Any discontinuities whose reflections do not exceed a height equal to 20% of the normal Back Reflection or do not reduce the height of the Back Reflection by more than 30% during movement of the transducer 2 inches in any direction, shall be considered acceptable. Indications exceeding those limits shall be repaired unless proven to be acceptable by other test methods. The above limits are established with the use of transducers having approximately 1 square inch of area.

(b) The allowable stress shall be one-fourth of the specified minimum tensile strength, i.e., 21,250 psi.

(c) Welding procedure qualification in accordance with Section IX shall be performed on test specimens of the material subjected to the same heat-treatment before and after welding as will be applied to the work. The material shall receive P-Number 5 Classification in Table Q-11.1.

(d) 1 Any discontinuities in excess of the maximum permitted in Pars. (a)1 and (a)2 and (a)3 shall be removed and may be repaired by welding after the base metal has been magnetic particle inspected to assure complete removal of discontinuities.

2 All weld repairs of depth exceeding 1 inch or 20% of the section thickness, whichever is the lesser, shall be inspected by radiography in accordance with Par. (a)2 and by magnetic particle inspection of the finished weld surface. All weld repairs of depth less than 20% of the section thickness, or 1 inch, and all weld repairs of sections which cannot be effectively radiographed shall be examined by magnetic particle inspection of the first layer, of each $\frac{1}{4}$" thickness of deposited weld metal and of the finished weld surface. Weld repairs resulting from the ultrasonic inspection shall be inspected by the same method. Magnetic particle testing of the finished weld surface shall be done after stress-relieving.

3 When repair welding is done after heat-treatment of the casting, the casting shall be stress-relieved.

(e) 1 For section thicknesses over 3" nominal, heat-treatment may consist of accelerated cooling from the proper temperature to obtain effects comparable to those developed by normalizing section thickness less than 3" nominal, followed by tempering at not less than 1200 F.

2 Castings subjected to accelerated cooling as outlined in (e)1 may be used in welded construction.

(f) Each casting shall be marked with the manufacturer's name and the casting identification, including material designation. The manufacturer shall furnish reports of the chemical and mechanical properties of the material and certification that each casting conforms to all requirements of this Case and to all other applicable requirements of the Code. This report shall include a record of the extent and location of repairs to the casting.

Case 1280

(Special Ruling)

Intermediate Strength Carbon Steel Plate of Firebox Quality With Improved Transition Properties; SA-212 Modified

Inquiry: Modifications have recently been made in requirements for chemistry and steelmaking practices to obtain improved transition properties in carbon steel hull plates for merchant ships. What modifications can be made to provide similar improvement in firebox quality intermediate strength carbon steel plate for Code construction?

Reply: It is the opinion of the Committee that intermediate strength carbon steel plate made in accordance with the following requirements for improving transition properties may be used in pressure vessels constructed in accordance with either Section I or Section VIII of the Code and to which the Code stamp is applied. All other requirements now in the Code apply.

Chemical Requirements

		Grade 65*	Grade 70*
Carbon, max., per cent	1" and under	0.25	0.28
	over 1" to 2" incl.	0.28	0.30
Manganese, per cent	Ladle	0.85/1.15	0.85/1.15
	Check	0.81/1.19	0.81/1.19
Phosphorus, max., per cent		0.035	0.035
Sulphur, max., per cent		0.04	0.04
Silicon, per cent	Ladle	0.15/0.30	0.15/0.30
	Check	0.13/0.33	0.13/0.33

* All plates shall be of Firebox Quality and made to fine grain practice.

Heat-Treatment

Plates up to and including $1\frac{1}{2}$ in. in thickness may be required to be normalized, if so specified. Plates over $1\frac{1}{2}$ in. in thickness shall be treated to produce grain refinement by normalizing.

Tensile Requirements

	Grade 65	Grade 70
Tensile strength, psi	65/77,000	70/85,000
Yield point, psi	35,000	38,000
Elongation in 8", min per cent	21	19
Elongation in 2", min per cent	24	22

Tensile strength only need be determined on the tension specimen taken from the top location and it shall not exceed 79,000 psi for Grade 65, nor 87,000 psi for Grade 70.

Bend Diameters

(Ratio of inside diameter of bend to thickness of specimen.)

	Grade 65	Grade 70
1 in. and under	1 1/3	2
over 1 in. to 2 in. incl.	2	2 1/3

Other Requirements

1 Plates shall otherwise conform to ASME Specification SA-212, Firebox Quality.

2 The following maximum stress values apply.

Grade	Spec Min Tensile	For Metal Temp Not Exceeding Deg F —20 to 650	700	750	800
65	65,000	16,250	15,500	13,850	11,40
70	70,000	17,500	16,600	14,750	12,00

3 For welding, all Code requirements applicable to ASME Specification SA-212 apply. The base material is assigned to Classification P-1.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the semi-annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1959

PAR. P-308(f) Revise to read:

All water walls and water screens which do not drain back into the boiler, and all integral economizers shall be equipped with blowoff valves conforming to the requirements of this paragraph and Pars. P-309, P-310, and P-311 or with drain valves conforming to Par. P-313.

PAR. P-311 (b):

Keep the first paragraph identical. Renumber the second paragraph reading: Only one blowoff . . . etc. . . . to Par. P-311(c).

PAR. P-312:

Reletter this Par. to read P-312(a).

PAR. P-313:

Reletter present Par. P-313 to read P-312(b) and add a new Par. P-313 to read:

When the valve or valves for waterwalls, water screens, and integral economizers in Par. P-308(f) are not intended for blowoff purposes but are intended for use only as a drain valve when the boiler is not under pressure, a single shutoff valve is acceptable, provided it is a type that can be locked in the closed position or provided a blank is inserted in a suitable flanged and bolted connection located on the downstream side of the valve. When such a single valve is used, it need not be designed specifically for blowoff service but shall be adequate for the pressure and temperature conditions at which the boiler operates.

Material Specifications, 1959

The Boiler and Pressure Vessel Committee approved adding to Section II the following revisions to specifications:

Forgings and Bolting

SA-29-59T
SA-105-59T
SA-181-59T
SA-182-59T
SA-193-59T
SA-194-59T
SA-320-59T
SA-350-59T

Castings

SA-216-59T
SA-217-59T
SA-278-59T
SA-351-59T
SA-352-59T

Plates

SA-20-59
SA-263-59T
SA-414-58T

Tubular Products

SA-53-59T
SA-83-59T
SA-135-59T
SA-178-59T
SA-213-59T (except in Section 4(d) add Grade "TP-321H" before TP-347H)

Copper

SA-214-59T
SA-249-59T
SA-312-59T
SA-333-59T
SA-334-59T
SA-335-59T
SA-376-59T

Aluminum and Aluminum Alloys

SB-209-59T (for alloys 990A, 996A, G1A, GM31A, GM40A, GM41A, GM51A, GR20A, GR40A, GS11A, clad GS11A, M1A, clad M1A, MG11A and clad MG11A only).

SB-210-59T (for alloys 996A, GR40A, GS10A, GS11A, M1A and clad M1A in the tempers shown).

SB-211-59T (for alloys CG42A, CS41A and GS11A in the tempers shown).

SB-221-59T (for alloys CG42A, GM31A, GM40A, GM41A, GM51A, GR40A and GS11A in the tempers shown).

SB-234-59T (except alloy GS11C has been deleted).

SB-235-59T (for alloys 996A, GM31A, GM51A, GR40A, GS10A, GS11A, M1A and clad M1A in the tempers shown).

SB-241-59T (for alloys GM31A, GM51A, GS10A, GS11A and M1A only).

SB-247-59T (for alloys CS41A, GS11A, GS11B and M1A in the tempers shown).

SB-308-59T (for alloys GM31A, GM40A, GM41A, GM51A and GS11A in the tempers shown).

The Boiler and Pressure Vessel Committee approved adding to Section II the following new Specification:

SB-348-59T. Grades 1, 2, and 3 only.

The Boiler and Pressure Vessel Committee approved the deletion of SA-48, Specification for Gray Iron Castings and SA-261, Specification for Heat-Treated Carbon Steel Bolting Material, from Section II.

Miniature Boilers, 1959

PAR. M-3(b) Revise the first sentence to read:

Steam boiler parts of not over 600 cu. in. in volume may be cast from copper alloy complying with requirements of Specification SB-61 or SB-62 of wall thickness not less than 1/4 inch.

Unfired Pressure Vessels, 1959

PAR. UG-35 Revise the title to read:

Spherically Dished Covers and Quick-Actuating Closures.

Designate the present Par. UG-35 as subparagraph (a) and delete footnote 1.

PAR. UG-35(b) Add a new Par. (b) to read:

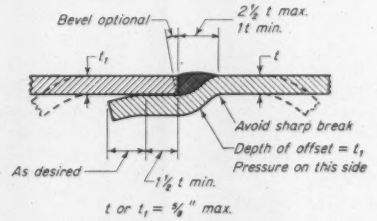
Quick-actuating closures, usually designated as quick-opening closures, which are built to give more rapid access to pressure vessels than closures of the multibolted type, shall be so designed that failure of any one holding element cannot result in the release or failure of any or all of the other holding elements. Closures of this type shall be so arranged that it may be determined at all times by visual external inspection that the holding devices are in good mechanical condition and that their locking elements are in full engagement.

Vessels with quick-actuating closures shall be installed with a pressure gage, pressure indicator, or warning device, and in addition, with means which will:

(1) Prevent pressure being applied unless the cover and holding elements are in the proper operating position, and

(2) Prevent disengagement of the holding elements while there is pressure loading on the cover.

FIG. UW-13(k) Revise Figure as shown.



(k) Butt Weld with One Plate Edge Offset

PAR. UF-31(b) In the note, revise reference to ASTM E 48 to read:

E140-58

TABLE UCS-23 Delete reference Note 17 and its explanation.

TABLE UNF-23 Nickel and High Nickel Alloys—Add the Stress Values as shown.

PAR. UNF-92 Add the following new Par.:

PAR. UNF-92 Weld Examination

(a) All welds, both groove and fillet, in vessels constructed of materials covered by Specifications SB-333, SB-334, SB-335 and SB-336 shall be examined for the detection of cracks by the fluid penetrant method. This examination shall be made following heat treatment if heat treatment is performed. All defects shall be removed by grinding, or grinding and filing.

(b) Fusion welded butt joints in vessels constructed of materials covered by Specifications SB-333, SB-334, SB-335, and SB-336 shall be examined radiographically for their full length as prescribed in Par. UW-51 when the plate or wall thickness at the welded joint exceeds $^3/_8$ inch.

APPENDIX V Add Fig. UNF-28.15 and Fig. UNF-28.16. (These charts are shown in Case Interpretations 1173 and 1194.)

APPENDIX X Delete this Appendix. (This subject is now adequately covered in the 1960 National Board Inspection Code.)

Welding Qualifications, 1959

TABLE Q-11.1 Add the following specifications under P-Number 8.

Material Specification	Psi Minimum Tensile
SA-182	
Gr. F304L	65,000
F316L	65,000
SA-213	
Gr. TP-304L	70,000
TP-316L	70,000
TP-321H	75,000
SA-240	
Gr. TP-304	75,000
TP-304L	70,000
TP-309S	75,000
TP-310S	75,000
TP-316	75,000
TP-316L	70,000
TP-317	75,000
TP-317L	75,000
TP-321	75,000
TP-347	75,000
TP-348	75,000
SA-249	
Gr. TP-304L	70,000
TP-316L	70,000
TP-321H	75,000
SA-312	
Gr. TP-304L	70,000
TP-316L	70,000
SA-351	
CH8	65,000
CH10	70,000

Type of Material
Alloy Pipe Flanges (18 Cr-8 Ni)
Alloy Pipe Flanges (18 Cr-8 Ni-Mo)
AISI-304L Seamless Alloy Steel Tubes
AISI-316L Seamless Alloy Steel Tubes
AISI-321H Seamless Alloy Steel Tubes
AISI-304 Plate (18 Cr-10 Ni)
AISI-304L Plate (18 Cr-10 Ni)
AISI-309 Plate (23 Cr-12 Ni)
AISI-310 Plate (25 Cr-20 Ni)
AISI-316 Plate (18 Cr-13 Ni-3 Mo)
AISI-316L Plate (18 Cr-13 Ni-3 Mo)
AISI-317 Plate (18 Cr-13 Ni-4 Mo)
AISI-317L Plate (18 Cr-13 Ni-4 Mo)
AISI-321 Plate (18 Cr-10 Ni-Ti)
AISI-347 Plate (18 Cr-10 Ni-Cb)
AISI-348 Plate (18 Cr-10 Ni-Cb)
AISI-304L Welded Alloy Steel Tubes
AISI-316L Welded Alloy Steel Tubes
AISI-321H Welded Alloy Steel Tubes
Alloy Pipe (18 Cr-10 Ni)
Alloy Pipe (18 Cr-13 Ni-3 Mo)
Alloy Castings (25 Cr-13 Ni-.08 C)
Alloy Castings (25 Cr-13 Ni-.10 C)

Add the following specifications under P-Number 5.

Material Specification	Psi Min Tensile	Type of Material
SA-182		
Gr. F-21	70,000	Cr-Mo Pipe Flanges 3 Cr-1 Mo

PARS. Q-3(5)(b) and QN-3(5)(b) Delete the words "*either*" and "*or box*" from the second sentence.

PARS. Q-24(c) and QN-24(c) Delete the last two sentences.

TABLE QN-11.1 Add the following Material Specifications under P-Number 44.

P-No.	Material Specifications	Product
P-44	SB-333 Ni-Mo (28 Mo-5 Fe)	Plate, Sheet
	SB-334 Ni-Mo-Cr (15.5 Cr-16 Mo-3.5 W)	Plate, Sheet
	Sb-335Ni-Mo (28 Mo-5 Fe)	Rod
	SB-336 Ni-Mo-Cr (15.5 Cr-16 Mo-3.5 W)	Rod

Delete SB-221 and SB-308, Alloy GM51A (5.1 Mg-0.8 Mn-0.10 Cr) Bars, Rods, Shapes, and Structural Shapes from P-24 and add under designation P-25.

TABLE QN-11.2 Add the following Electrodes under F-47:

F-No.	Filler Alloy		
F-47	Ni-Mo (28 Mo-5 Fe) Ni-Mo-Cr (15.5 Cr-16 Mo-3.5 W)		
Metal Arc	Oxy-Acetylene Submerged Arc		Inter-Gas Arc
E3N1B E3N1C			ERN7B ERN7C

FIGS. Q-8 and QN-8 Under notes revise dimension C from $3^1/_4$ in. to read $3^3/_8$ in.

Max Allowable Stress Values to Be Added to Table UCS-23 Nickel and High Nickel Alloys

Material and Spec No.	Condition	Specified Tensile Strength	Min Yield Strength 0.2% Offset	For Metal Temperatures not Exceeding Deg F 100	200	300	400	500	600	700	800	900	1000
Nickel-Molybdenum													
ROD													
SB-335	Hot finished annealed $^1/_{16}$"-$3^1/_2$" incl	100000	46000	22000	20000	20000	20000	20000	20000	20000	—	—	—
BOLTING													
SB-335	Hot finished annealed $^1/_{16}$"–$3^1/_2$" incl	100000	46000	11200	10000	9800	9100	8800	8300	8300	—	—	—
PLATE, SHEET													
SB-333	Hot rolled annealed under $^1/_{16}$"	115000	50000	22000	20000	20000	20000	20000	20000	20000	—	—	—
SB-333 (Plate)	Hot rolled annealed $^1/_{16}$"$^3/_4$" incl	100000	45000	22000	20000	20000	20000	20000	20000	20000	—	—	—
SB-333 (Plate)	Hot rolled annealed over $^3/_4$"-$2^1/_2$" incl	90000	45000	22000	20000	20000	20000	20000	20000	20000	—	—	—
Nickel-Molybdenum-Chrome													
ROD													
SB-336	Hot finished annealed $^1/_{16}$" to $3^1/_2$" incl	100000	46000	22000	20000	20000	20000	20000	20000	19000	19000	18000	18000
BOLTING													
SB-336	Hot finished annealed $^1/_{16}$" to $3^1/_2$" incl	100000	46000	10000	10000	9200	8500	8500	8500	8500	8500	8500	8500
Plate, Sheet													
SB-334	Hot rolled annealed under $^1/_{16}$"	115000	50000	22000	20000	20000	20000	20000	20000	19000	19000	18000	18000
SB-334 (Plate)	Hot rolled annealed under $^1/_{16}$"	100000	45000	22000	20000	20000	20000	20000	20000	19000	19000	18000	18000
SB-334 (Plate)	Hot rolled annealed over $^3/_4$" to $2^1/_2$" inc	90000	45000	22000	20000	20000	20000	20000	20000	19000	19000	18000	1800

Current Engineering: Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Niels Bohr Speaks at CERN Proton Synchrotron Inauguration, February 5, in Geneva

THE CERN 25-thousand-million electronvolt (25 GeV) proton synchrotron—referred to as PS by the "Cernese"—was inaugurated officially on Friday, Feb. 5, 1960, by Prof. Niels Bohr, Nobel Prize Winner for Physics.

This particle accelerator, or atom smasher, located near Meyrin, Geneva, Switzerland, is considered the largest in the world.

Professor Bohr emphasized the important part international co-operation has played through the ages in the development of science, and especially in the exploration of the world of atoms, which has given us so deep an insight into the constitution of matter.

While, in the initial stages of this development, he observed, the apparatus needed for experimental atomic research did not exceed the facilities of ordinary physical laboratories, closer studies of the properties of elementary particles have called for instruments of a size and complexity which would prevent many countries with limited resources from taking an active part in such investigations.

After briefly recalling the sequence of discoveries which form the background for this situation, Professor Bohr stressed how the establishment of the European Organization for Nuclear Research and the great success of its endeavors have created new opportunities for international co-operation in a field of research with great promises for the elucidation of fundamental physical problems.

He concluded by expressing the admiration of the world-wide community of physicists for what already has been achieved by CERN and their expectations as to its future contributions to a most important task.

Completed after six years of joint effort by the 12 founding Member States of CERN, the proton synchrotron is a circular accelerator designed to give protons—the nuclei of hydrogen atoms—the very high kinetic energies necessary in using these submicroscopic particles as "missiles" to strike other atomic nuclei, penetrate them, and give rise to events which provide physicists with valuable information about the fundamental structure of matter.

CERN is a multinational organization which works exclusively in the field of pure and fundamental research. CERN is not concerned with the applications of nuclear energy, whether pacific or military.

This organization therefore is building neither reactors nor other equipment or installations making practical use of nuclear energy.

Despite the fact that nuclear physics exists since the beginning of the century, attention of the ordinary public has been drawn to it rather by its more sensational applications than by the fundamental research behind these.

CERN, however, is dedicated to the satisfaction of scientific and intellectual curiosity in the highest sense of this word—the ultimate secret of matter.

The CERN proton synchrotron constitutes the hitherto most perfect example of scientific and technical collaboration among the countries of Europe.

And even on the political level, as an international organization, CERN can be looked upon as an exemplary model of multinational co-operation, a veritable "school for Europe."

CERN proton synchrotron—world's largest atom smasher. View of the interior of the rung building of CERN's 25 thousand million electronvolt (25GeV) alternating gradient proton synchrotron, world's largest atom smasher. This building, encapsulated by earth, is 656 ft in diam, and in it, protons are accelerated up to 99.93 per cent of the speed of light a number of the one hundred units of the 3900-ton guiding-field electromagnet can be seen on their shock-proof concrete supporting girder, which is architecturally independent of the ring building.

Harvard Computing Machine Parses Russian Sentence

Scientists at Harvard have discovered how to analyze the grammatical structure of Russian sentences by computing machines. The discovery is a significant advance in the attempt to translate Russian into English by machine.

For the past seven years, linguists and mathematicians at the Harvard Computation Laboratory have been preparing, under the direction of Anthony G. Oettinger, assistant professor, an automatic Russian-English "dictionary," which now contains 15,000 Russian words and their English equivalents. This dictionary, in the form of magnetic tape in the memory section of a Univac computer, can produce rough, word-for-word translations of Russian scientific articles. But it could not unravel the complexities of syntax within Russian sentences.

A new technique, known as "predictive analysis," now is being used to resolve these puzzles.

Predictive Analysis is based on fundamental work done by Mrs. Ida Rhodes of the Applied Mathematics Division at the National Bureau of Standards. As used by Professor Oettinger and his associates, it identifies the grammatical role of each word in the sentence being translated, such as subject, verb, or object. By checking the inflected endings of Russian words, the system can connect a word with its own modifiers.

The system of predictive analysis is based on a few fundamental concepts. The first is that of "alternative functions." A single word in Russian may be eligible for several jobs within the sentence being translated. A particular adjective, for example, may be either nominative singular (as in English, "I"), or accusative singular (as in English, "me"). To decide which form the word actually has, the machine makes use of a "prediction pool."

Prediction Pool. The prediction pool enables the machine to decide whether an adjective modifies the subject or object by its position in the sentence. If the subject of the sentence has not yet appeared, the machine will select the nominative form for the adjective, putting the possibility that the adjective modifies the sentence's object in a "hindsight" section of its memory. If the subject has already appeared in the course of analysis, the machine will choose the accusative form as most probable.

Once the subject of a sentence has appeared during the analysis, the prediction that the next word will be the subject is removed from the prediction pool. The machine proceeds through the sentence in this way, one word at a time, until it reaches the end. Each word determines the most probable grammatical form of the next word in the sentence. At this point the machine checks to see whether all the requirements for a complete sentence have been met. If they have, the machine proceeds to the next sentence. If not, the machine checks its hindsight section in an attempt to correct the situation, trying various alternatives until the analysis of the sentence is complete. If the sentence cannot be analyzed, the machine notes the fact. This enables the linguists and mathematicians to correct the machine's program so that it will be able to analyze sentences of this form in the future.

To Parse a Sentence. The analysis of a Russian sentence requires a treelike diagram, like the English sentence diagrams of elementary schools. The diagram shows the phrases and clauses of the sentence as branches stemming from the subject, verb, and object which form the trunk of the tree. However, both the human mind and a computing machine receive sentences as chains of words in a straight line.

The system of predictive analysis permits a computing machine to approach a sentence in the same way a human being does, one word at a time and from left to right. Certain key words, such as conjunctions and prepositions, indicate the branchings of the sentence diagram. The machine can recognize such branchings, and distinguish between the main subject and verb of the sentence, and the subjects and verbs which may occur in dependent clauses.

Final Output. The final output of the machine is a sheet containing the original Russian sentence, the various possible equivalents of each Russian word in English, and the grammatical role of each word in the sentence. With this information, a person who knows little or no Russian can prepare a finished translation. The next step in the machine-translation research will be to program a computing machine to turn this material into a finished English translation, without the need for a human editor.

MEETINGS OF OTHER SOCIETIES

April 11–13

American Management Association, West Coast conference on distribution management, Fairmont Hotel, San Francisco, Calif.

April 11–13

National Safety Council, seventh annual Western Safety Congress and exhibits, Ambassador Hotel, Los Angeles, Calif.

April 12–13

AIEE, technical conference on electrification of materials-handling equipment, Sheraton Hotel, Philadelphia, Pa.

April 19–21

American Society of Lubrication Engineers, annual meeting, Netherland-Hilton Hotel, Cincinnati, Ohio.

April 20–22

IAS, NASA, and Rand Corporation, manned space stations symposium, Ambassador Hotel, Los Angeles, Calif.

April 21–22

AIME, Southwest Metals and Minerals conference, Ambassador Hotel, Los Angeles, Calif.

April 21–22

Oklahoma State University, seventh annual heat-transfer conference, "A Survey of Radiation Phenomena and Heat Transfer Equipment for Space Flight Application," Stillwater, Okla.

April 21–28

American Society of Tool and Manufacturing Engineers, annual conference, Statler Hotel, and tool show, Detroit Artillery Armory, Detroit, Mich.

April 25–26

The Society of the Plastics Industry (Canada), Inc., annual Canadian Section conference, London, Ont., Canada.

April 25–27

Association of Iron and Steel Engineers, spring conference, Sheraton Hotel, Philadelphia, Pa.

April 25–27

Canadian Institute of Mining and Metallurgy, annual meeting, Royal York Hotel, Toronto, Ont., Canada.

April 25–29

International Atomic Energy Agency, seminar on codes for reactor computations, Vienna, Austria.

April 26–28

Industrial Health conference, Rochester War Memorial Auditorium, Rochester, N. Y.

(Continued on page 126)

Meetings of Other Societies (*Continued*)

May 2–3

ASA, spring Company Member conference, Sheraton, Hotel, Philadelphia, Pa.

May 2–4

IRE, national aeronautical electronics conference, Dayton, Ohio.

May 2–5

Instrument Society of America, National Flight Test Symposium, San Diego, Calif.

May 3–5

The Iron and Steel Institute, annual general meeting, London, England.

May 3–5

Western Joint Computer conference, Jack Tar Hotel, San Francisco, Calif.

May 3–5

Purdue Industrial Waste conference, Purdue Memorial Union Building, Lafayette, Indiana.

May 3–13

Mechanical Handling Exhibition, organized by the Iliffe journal, *Mechanical Handling*, Earls Court, London, England.

May 5–6

ASCE, Engineering Mechanics Division conference on structural mechanics, Purdue University, Lafayette, Ind.

May 7–13

SPI, national conference and annual meeting, cruise on *Queen of Bermuda*.

May 9–12

ISA summer instrument-automation conference and exhibit, Civic Auditorium, San Francisco, Calif.

May 9–13

American Foundrymen's Society, castings congress and exposition, Philadelphia, Pa.

May 9–13

American Society for Metals, Southwestern Metal Exposition and Congress, Dallas, Texas.

May 10–13

IAEA, Symposium on Fuel Element Fabrication with special emphasis on cladding materials, Vienna, Austria.

May 12–14

American Institute of Industrial Engineers, annual meeting, Dallas-Sheraton Hotel, Dallas, Texas.

May 15–20

American Water Works Associaton, annual Convention, Miami Beach, Fla.

(*For ASME Coming Events see pag 149.*)

COMING MEETINGS

Textile Standards

The fourth plenary meeting of the International Organization for Standardization's Technical Committee No. 38 on Textiles will be held in England, May 19–28. Subcommittees on yarn testing and fiber testing, and a working group on cotton fiber tests will meet also. ASA Sectional Committee L23 supervises these activities and is now recruiting an American delegation.

Nuclear Energy

International Nuclear Standards will be the topic for discussion as Technical Committee No. 85 of the International Organization for Standardization convenes in Geneva, Switzerland, May 23–June 1. Sessions will be held on nuclear energy terminology, definitions, units, symbols, radiation, reactor safety, and radioisotopes. The United States, through ASA, has the secretariat for this activity.

Columbia and Cornell Placement Offices Differ on Outlook for 1960 Graduates

RECENT news items from Columbia and Cornell Universities present divergent opinions on the future of the 1960 engineering graduate.

At Columbia, the director of placement reports that an optimistic outlook for business conditions in 1960 has resulted in an increased demand for college-trained engineers at higher salaries. He states that at Columbia 200 companies are seeking mechanical and electrical engineers and only 20 mechanical and 40 electrical engineers are scheduled to receive BS degrees from the school in June.

At Cornell University, on the other hand, director of the office of student personnel, College of Engineering, states that an engineering degree is no longer a passport for a college graduate to executive-sized jobs and salaries. He explains that the intense competition for engineering graduates which developed during recent years, caused many companies to train liberal arts graduates and technicians to fill jobs previously held by engineers.

An independently conducted survey, however, shows that Cornell engineering graduates may have less to fear than their counterparts at other engineering colleges and universities. Results indicate that Cornell's five-year program is paying dividends for graduate engineers.

Last June's Cornell engineering graduate started working for an average salary of $530 per month. Starting average salary for Columbia engineering graduates, most of them also on a five-year curriculum, was $520.

PEOPLE

New Officers. LEROY K. WHEELOCK has been elected secretary of Engineers Joint Council, replacing Esworthy P. Lange, Mem. AMSE, who resigned to become executive secretary of the American Institute of Industrial Engineers, on March 1, 1960. Wheelock has been assistant secretary of EJC since 1956 and, more recently, executive secretary of the Engineering Manpower Commission. He is a member of the AIME, ASEE, Committee on Specialized Personnel, Office of Civil and Defense Mobilization, and the National Defense Executive Reserve.

RICHARD H. TATLOW, 3RD, Mem. ASME, has been elected president of The American Institute of Consulting Engineers. Tatlow is president of Abbott, Markt & Company, New York City. Also elected, among the members of the Governing Council, is Gilbert I. Ross, Mem. ASME, partner, Ross & Company, New York City.

Technical Publication. HAROLD E. GREEN has been named managing director of *Modern Castings*, technical publication of the American Foundrymen's Society, Des Plaines, Ill.

Technical Ambassadors. RODNEY D. CHIPP, director of engineering for Communications Systems, Inc., a wholly owned affiliate of IT&T, and his wife, BEATRICE A. HICKS, Mem. ASME, president of Newark Controls Company, Bloomfield, N. J., left March 13 for the tour which will take them to five South American countries.

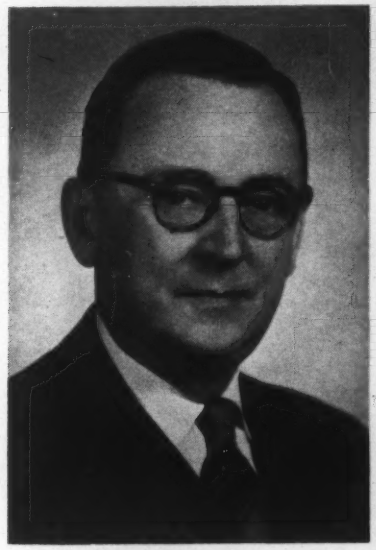
The "engineering" couple will represent National Society of Professional Engineers as "people to people ambassadors" for the engineering profession. They were selected for the role by the National Society from among more than 2000 candidates.

Retirement. CHESTER R. EARLE, Mem. ASME, editor of *Power Engineering*, has retired from that post and has been succeeded by Robert F. McCaw, Mem. ASME, managing editor. Earle will continue to be associated with the magazine as Special Projects Editor. A registered PE in Illinois, Earle is a member of many engineering and professional organizations.

McCaw joined the magazine as associate editor in 1957 after many years of experience in both public utility and industrial power engineering. In 1958 he was made managing editor.

George McKinstry Dick, Assoc. Mem. ASME, of Sherbrooke, Que., and Montreal, Que., has been elected president of The Engineering Institute of Canada for 1960–1961. He will succeed J. H. Hanna, of Calgary, Alberta, and will be inducted into office at the 74th Annual Meeting of the Institute at Winnipeg in May. He is chief engineer of the Canadian Ingersoll-Rand Company, Ltd., which company he joined in 1915.

G. McK. Dick elected President of EIC



ASME Northern New Jersey Subsection receives its charter as a full Section, Feb. 10, 1960. **Left to right are:** William Cooperman, former chairman of Northern New Jersey Section; A. M. Perrin, a director, ASME; Edward Miller, former chairman of Northern New Jersey Section; G. R. Hahn, Vice-President, ASME Region II; W. C. Krutzsch, Jr., present chairman of Northern New Jersey Section; V. W. Smith, a director, ASME; and L. J. Schmerzler, member, Executive Committee, Northern New Jersey Section.

Paul G. Shewmon, **left,** assistant professor of metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa., is a double award recipient at AIME annual meeting in New York City. He receives Alfred Noble Prize as well as Rossiter W. Raymond Memorial Award. Noble prize is sponsored jointly by ASCE, AIME, ASME, AIEE, and the Western Society of Engineers. Raymond Award is given by AIME. Noble Prize and Raymond Award both recognize technical papers of outstanding merit. **Right** is Howard G. Pyle of Los Angeles, president of Monterey Oil Company and outgoing president of AIME.

Sol Domeshek, Assoc. Mem. ASME, is congratulated by Capt. E. C. Callahan, Commanding Officer and Director, U. S. Naval Training Device Center, upon receiving his eighth patent award while employed at the Center. Domeshek's latest patent, which has been offered to the Government on a royalty-free basis, was for the development of an Optical Radar Simulator. His seven other patents have been for projection, stereoscopic, and radar simulation equipment. **Left to right:** Larry Epstein, patent counsel; Sol Domeshek; Capt. E. C. Callahan; and Eugene Nowicki, head of the Center's audio-visual department.

R. W. Warren, Mem. ASME, is among the three civilian scientists at the Army's Diamond Ordnance Fuze Labs, Washington, D. C., who have invented a family of control devices which use gas or liquids instead of electric current to operate units and which have no moving parts

EDUCATION

Challenge of the 1960's

ACCORDING to John R. Dunning, Mem. ASME, and dean of the Columbia School of Engineering, the 1950–1960 decade at Columbia University produced some of the most significant scientific advances in the University's 205-year history. It is probable that the decade just ended surpassed in scientific achievement all previous decades, including 1930–1940 when research on heavy water and atomic fission helped usher in the age of the atom. But, Dean Dunning believes that the advances made in the past decade foreshadow even more outstanding progress during 1960–1970. "Many of the projects organized in the last decade—such as construction of a seismograph to be landed on the moon—will in all probability come to fruition in the next ten years, as will many new undertakings which now are in the planning stage." Columbia research in the 1950–1960 era received five Nobel Prizes in 1955–1957.

Summer Courses

University of California, University Extension, Berkeley, Calif., offers numerous courses in the field of nuclear technology and several courses pertaining to ground-support systems for missiles and space vehicles.

Industrial Management Center, Lake Placid Club, New York, material handling and packaging course, June 12–25, 1960.

Massachusetts Institute of Technology, Cambridge, Mass., fluid power control, June 14–24, 1960.

Pennsylvania State University, University Park, Pa.:

- Architectural and engineering planning for atomic shelters, July 10–22.
- Structural engineering and radiation shielding for atomic shelters, July 24-August 5.
- Underwater missile engineering, July 10–22.
- Machinability seminar, June 5–10.

Purdue University, Lafayette, Ind., design of experiments for statisticians, quality-control personnel, and engineers, June 7–17, 1960.

Rensselaer Polytechnic Institute, Troy, N. Y., technical writers' institute, June 13–17, 1960.

We Can Conquer Interplanetary Space With Materials, Energy, Technology, and Men . . .

THE Cleveland Post of the American Ordnance Association bestowed the General Benedict Crowell Gold Medal on Dr. Wernher von Braun "for distinguished service in behalf of the security of the nation, and the cause of a just and lasting peace throughout the world," at a dinner held recently in Cleveland, Ohio.

In accepting this latest honor, Dr. von Braun discussed our chances of conquering outer space and the following are some of his salient remarks:

"While attending a technical meeting in Washington, D. C., I had the opportunity to chat briefly with Professor Leonid Sedov, chairman of the space exploration committee of the Academy of Sciences in the Soviet Union. Most of our conversation was essentially scientific. I came away with the definite feeling that there is no question in Russia that space exploration should be anything less than a major and persistent effort; that ambitious long-range space projects are under way in the USSR, and that impressive and new demonstrations of the Russian technological progress should be expected year after year. There is no distinction behind the Iron Curtain between military and civilian rocket programs. The Russians are realists. They put their most experienced men in charge and they exert their best efforts to accomplish scientifically and technically sound objectives."

"Where do we stand today in the face of this competition?" asked Dr. von Braun. "First, that we are engaged in scientific and engineering activities of an entirely novel category. More is unknown than is known. Much of what we have done, much of what is expected of us, strains the state of the art to the breaking point. We must design and fabricate vehicles that can function for months and years under conditions which do not exist on Earth. We must use materials that will be exposed to extreme vacuum, to high-radiation activity, and other extraordinary phenomena encountered only in space. The hypersensitive guidance and control systems that steer these fire-breathing monsters must operate over long periods under great stress with any possibility of repair or maintenance."

Materials. "If I were to attempt to summarize the areas of greatest importance which will engage our major effort in the months and years before us, I would begin with materials. Throughout the ages man's progress has been measured largely by his ability to exploit natural materials. The Stone Age, the Bronze Age, the Iron Age—and now the Space Age—have marked his advance in the construction of devices to extend his mastery over natural environments."

Energy. "Next I would mention the sources of energy—the factor which man employs to work materials into the shape and size of useful machines and to propel those machines as he wills. History has recorded his successive applications of horse power, sail, steam, chemical fuels, electrical energy, and now the controlled atom. We are still dependent upon chemical fuels to power our rocket engines, but work is under way in two new areas—ion propulsion and nuclear energy. Both are particularly attractive for the propulsion of deep space ships from take-off points in space rather than from boosting rockets out of the Earth's gravitational field."

Technology. "A third element in this equation is a dynamic technology. Having defined natural laws, man has gained the fundamental knowledge by which he can combine materials and energy in useful devices that provide him with means of transportation and of production."

Man. "The fourth and most vital factor in our future progress is man himself. He alone can combine the other elements into a meaningful whole. To achieve this, he must be technically trained. The dominant position of technology today and the far-reaching influence it will exert upon society tomorrow points up the need to prepare our children by reorienting our educational system in the direction of scientific and technological fields."

"We are risking grave danger if we regard this only as a race between rival teams of missile builders. The communist challenge extends across the total spectrum of human activities. It challenges you and me, and all of us, to assert and demonstrate the superiority of the free way of life over a thesis for living that is entirely repugnant to our traditions."

"This is our struggle, today," he concluded. "It will be our children's struggle tomorrow. If freedom is to prevail against the forces of evil, we must exploit our creative abilities to the maximum and reinforce the moral and ethical foundations upon which our social order rests."

Two-Ton Project. This two-ton magnetic unit is part of an industrial cyclotron and has particular attraction for Mark Keller, **left,** and James Kraus, students at Levittown High School, Long Island. Mark and James are part of the teen-age team that's building the cyclotron as a project of the school's JETS club. JETS (Junior Engineering Technical Society) is a nationwide organization, jointly sponsored by industry and education, to stimulate youngsters' interest in things scientific. The Levittown Chapter, one of 11 on Long Island sponsored by Republic Aviation Corporation, was just named "most outstanding" club in the East at a regional JETS conference held at Farmingdale.

. . . But We Must Have More Qualified Young Engineers Entering the Profession

For the second consecutive year, enrollment in America's accredited engineering colleges has dropped.

In the fall of 1959, 240,063 students registered in engineering; in 1958 there were 249,950, and in the fall of 1957 the total was 257,777.

Under the influence of high enrollments in the mid-1950's, the number of engineering graduates continues to rise; in the year ending in June, 1959, 41,132 degrees were given in various fields of engineering. But a study of recent enrollments would indicate that there will be fewer engineering graduates within the next one or two years, according to the American Society for Engineering Education.

The Society recently released its annual survey of enrollments in schools having accredited engineering curriculums. The figures, compiled by the U. S. Office of Education, come from 154 engineering schools in the United States and are assembled each year under a joint ASEE-Office of Education project. They cover all engineering colleges with one or more engineering curriculums accredited by the Engineers' Council for Professional Development.

Total engineering enrollment in the fall of 1959 was down 4 per cent from 1958 and 6.9 per cent from 1957, according to the survey. A decrease in undergraduate enrollment first reported in 1958 continued in 1959 with a 5.7 per cent drop during the year. These engineering enrollment decreases came at a time when total college enrollments were rising—in all, by 10.9 per cent during the two-year period. In 1959, engineering students accounted for only 7.1 per cent of all college students, compared with the high of 8.4 per cent in 1957.

B. R. Teare, Jr., President of ASEE states, "This continued decrease in enrollment, and particularly the decrease in freshmen, is a matter of great concern to all of us. The studies of the Engineering Manpower Commission indicate not only that the demand for engineers is increasing, but also that it is expected to accelerate. Our ability to expand the production of consumer goods to satisfy the requirements of our multiplying population depends upon a large and increasing supply of well-educated engineers. In addition, they are needed for our space exploration program and the development of ballistic missiles, and of other weapons of defense. The demand from all of these sources for more engineers will increase in future years, and will have to be met by the students presently enrolled in engineering schools and those who will enroll in the next few years. If the industrial growth of the country and the defense programs are not to be impaired, the trend of the past two years must be reversed. Furthermore, every time there is a readjustment of business activity, the press and the general public should not cry 'Wolf' and thus discourage students from undertaking the study of engineering."

Engineering enrollments for advanced degrees continued to show increases in the fall of 1959, but the rate of growth is decreasing, according to the ASEE-Office of Education figures. Of 34,731 graduate students this fall, 28,734 were registered for the master's degree, 357 for professional degrees, and 5640 for doctor's degrees. This represents a 6 per cent increase in master's and 18.4 per cent increase in doctor's registrants over the previous year.

Of the 41,132 engineering graduates who received degrees during the year ending in June, 1959, 33,695 earned bachelor's degrees, 7.9 per cent more than in 1958 and 21.4 per cent more than in 1957. There were 6723 master's degrees, a jump of 16.9 per cent in the year and 29.2 per cent in the two-year period. The 714 doctor's degrees represented an increase of 10.4 per cent over 1958 and 19.8 per cent over 1957. Engineering accounted for 9.5 per cent of all master's degrees given in 1959 and 7.7 per cent of all doctor's degrees.

"The continued increase in post-graduate enrollment," Dean Teare stated, "is reassuring, but if undergraduate numbers continue to decrease, it is obvious that the urgently needed growth of graduate enrollment cannot be expected."

The demand for quality is even greater than for numbers, in industry, in government, and especially in educational institutions. The supply of qualified young men to strengthen present faculties is still the greatest problem in engineering education.

The report of engineering enrollments released by ASEE was compiled by Wayne E. Tolliver of the Higher Education Statistics Unit in the U.S. Office of Education and Dr. Henry H. Armsby, Chief for Engineering Education in the Office of Education's Division of Higher Education.

United Engineering Center

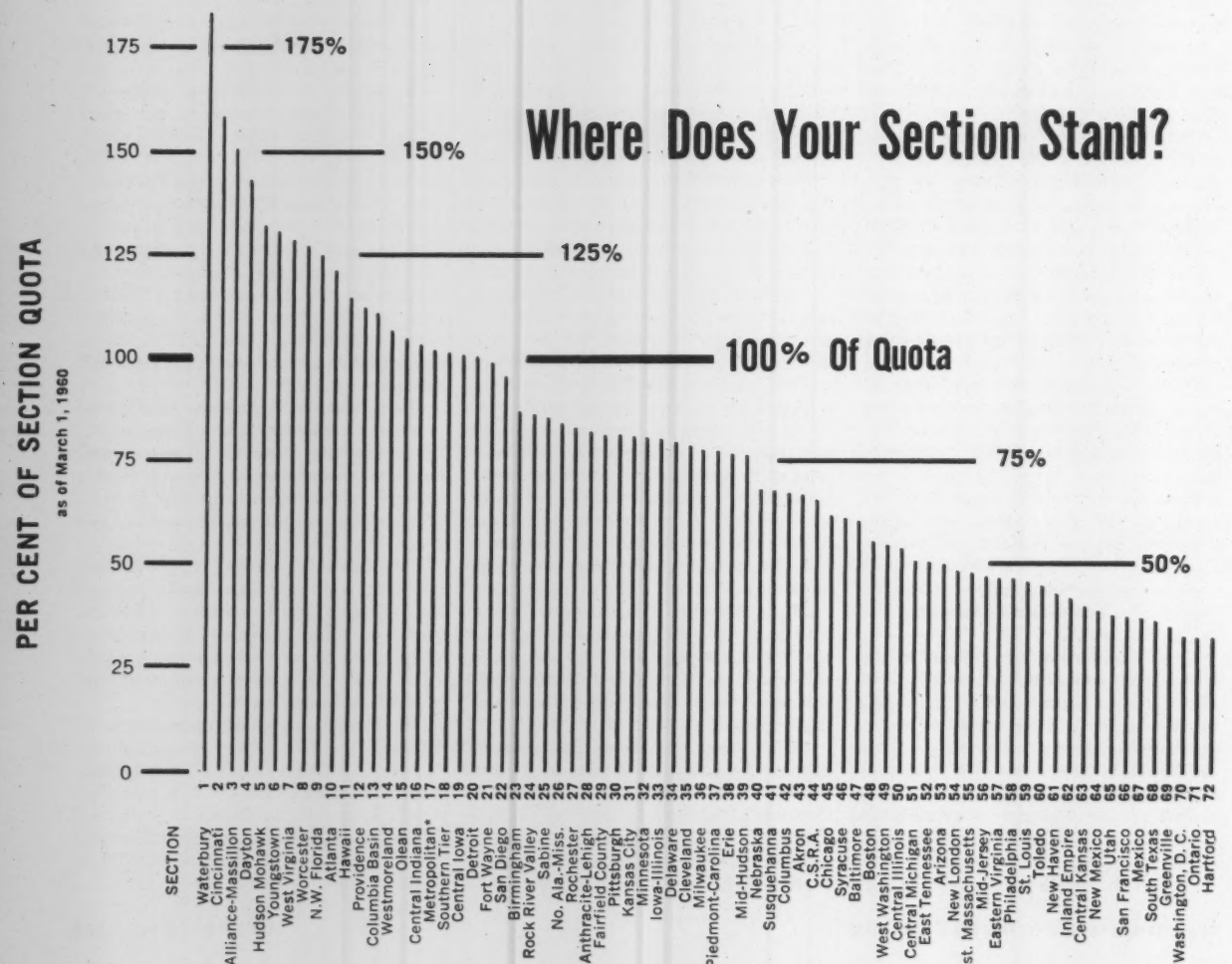
Construction Vs. Fund Campaign:

CONTRASTING pictures were painted last month of progress in the ASME Member Gifts Campaign on the one hand, and physical construction of the United Engineering Center on the other.

At the building site, construction contractors said that work is right on schedule: "We started pouring concrete for footings on February 2, and we expect to have some basement slabs poured by April 1. At the rate things are going we may even beat that date."

Meanwhile, progress reports on ASME's fund-raising activities showed a net increase in funds during the month of only 1 per cent of quota. At this rate it would take another 18 months to secure the bare minimum of ASME's quota.

The last of the major subcontracts was signed during February, according to United Engineering Trustees.



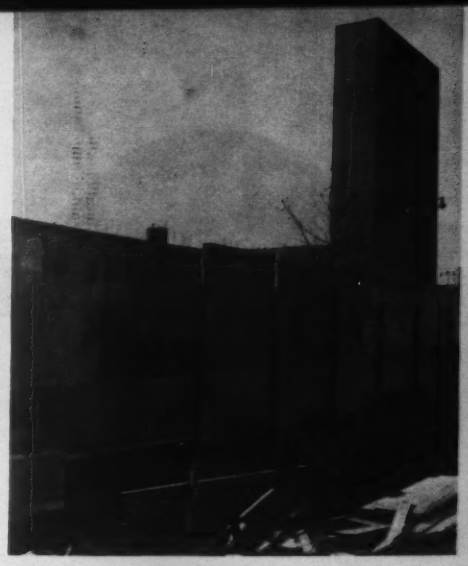
A Study in Contrasts

A construction supervisor says: "From the point of view of weather, condition of the site, and a general absence of tough problems, this has been about the smoothest job I've ever worked on."

During the same month, 43 of the ASME Sections which have not fulfilled their quota reported absolutely zero progress. Some Sections, most of them at the bottom of the performance list, have reported no progress in the past nine months.

The situation prompted one member active in fund-raising efforts to say, "If all of us in ASME start doing our jobs as well as the people putting up this building are doing theirs, our quota will be met."

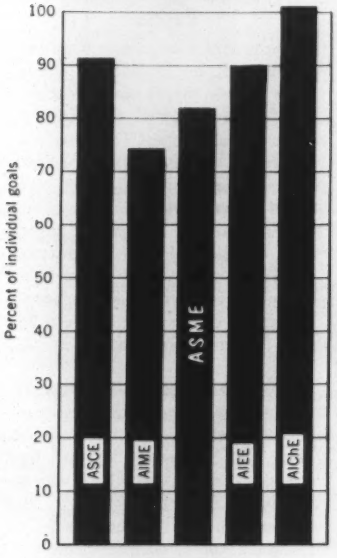
Bright spots in the fund campaign were Detroit, 100.9, and Central Iowa, 101.7, which passed their 100 per cent quota marks.



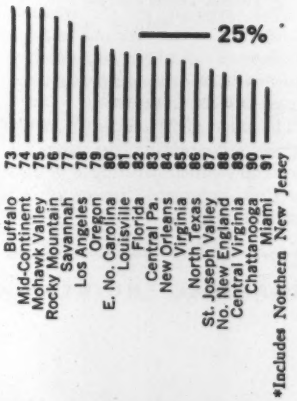
Concrete forms rise above fence surrounding site of United Engineering Center on way to becoming part of the new 18-story home of the engineering profession in New York City

Engineer surveys UEC site through his transit. Newly strung construction line can be seen in background. Workmen construct new concrete forms on 48th Street side of the site.

How Is ASME Doing?



United Engineering Center Building Fund Member Gifts Campaign status as of March 4, 1960



A giant shovel digs into the earth on UEC Site. Photo taken in March shows rapid progress being made in construction of building.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Dallas Readies for Big Sixties

ASME Semi-Annual Meeting and Aviation Conference, June 5–9

THE North Texas Section of The American Society of Mechanical Engineers will be Host Section to the 1960 Semi-Annual Meeting and Aviation Conference, June 5–9, at the Statler-Hilton Hotel, Dallas, Texas.

Located in the heart of the expanding southwest, well-rounded technical sessions, standout social events, and tours to key industries are being planned to make this the best meeting of the year for members and their guests.

Technical Program

Highlighted with many recent developments in the aviation field, the 45-session technical program should be interesting and informative to all. There is an extensive aviation program and one or more sessions will be devoted to heat transfer, human factors, Junior Engineers, machine design, management, materials handling, nuclear engineering, petroleum, and process industries.

A special session will be sponsored by the Professional Practice Committee, the subject of which will be "The Conflict of Interests as Exemplified by the Furnishing of Free Engineering by Manufacturers."

Feature Events

Following Sunday afternoon registration, the North Texas Section will be hosts to an "early bird" reception where members and their guests are invited to meet with other early arrivals.

Monday's program will be highlighted by the President's Luncheon with an address by ASME President Walker L. Cisler. This is to be followed in the afternoon by a Society Business Meeting at 4:45 p.m. Special Division Luncheon meetings are being planned by the Management and Petroleum Divisions. The Management Division will hold its luncheon on Tuesday, and Wednesday's schedule calls for the luncheon by the Petroleum Division.

"Hoops and hollers" will launch a big western ranch party on Tuesday evening. Wild West rodeo, dinner, western entertainment, and tour of ghost town will top a most enjoyable evening at the Austin Patio Ranch. Buses will head for the ranch starting at 4:30 p.m.

The Banquet will be held Wednesday evening with Chester H. Lauck of Continental Oil Company as the principal speaker. Some will remember Mr. Lauck as Lum of the famous Lum and Abner team. He has entitled his talk "The Eleventh Hour."

Inspection Trips

Planned inspection trips of activities in the Dallas-Fort Worth area will be centered around a number of aviation and electronics industries, including Texas Instruments, Inc. Special trips to power plants, petroleum research laboratories, and other facilities of interest are also being considered. A most interesting program for the women is being planned by Mrs. Dale Cunningham and her committee and will include the theater, luncheons, and tours of the city among its many activities.

Orders for ASME Technical Papers

ONLY copies of *numbered* ASME papers will be available. Please order only by paper *number;* otherwise the order will be returned. Order your copies of *numbered* papers by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. They will be available as separate papers until April 1, 1961. Production problems may delay the availability of some numbered papers. However, orders will be held for such papers only until May 20, 1960.

Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten are $3 to members; $6 to nonmembers.

Copies of unnumbered papers, listed in this program, *are not available* in advance of the meeting because the review of these manuscripts had not been completed when the program went to press.

The issue of MECHANICAL ENGINEERING containing the story of the Semi-Annual Meeting will also carry a complete listing of all available papers.

Registration Schedule

Sunday, June 5	2:00 p.m. to 5:00 p.m.
Monday, June 6	8:00 a.m. to 3:00 p.m.
Tuesday, June 7	8:00 a.m. to 3:00 p.m.
Wednesday, June 8	8:00 a.m. to 3:00 p.m.
Thursday, June 9	8:00 a.m. to 3:00 p.m.

SEMI-ANNUAL BANQUET

B WEDNESDAY, JUNE 8 7:00 p.m.

Speaker: *Chester H. Lauck*, Continental Oil Company, Houston, Texas

Subject: **The Eleventh Hour**

Presentation of Worcester Reed Warner Medal to *Samuel Glasstone*, U. S. Atomic Energy Commission, Los Alamos Scientific Laboratory, New Mexico

PRESIDENT'S LUNCHEON

L MONDAY, JUNE 6 12:15 p.m.

Address by: *Walker L. Cisler*, ASME President

AVIATION SESSIONS

1 MONDAY, JUNE 6 9:30 a.m.

Short Range Rapid Transit—Air Traffic

Progress Report on Local Service Turboprop Aircraft,[1] by *G. R. Henry*, Bonanza Air Lines

Helicopter Experience and Planned Convertiplane Operation,[1] by *J. E. Gallagher*, New York Airways, Inc.

Convertiplanes in Commercial Operation,[1] by *D. E. Postle*, Kaman Aircraft Corp.

An Assessment of Information on VTOL/STOL Vehicles as Applied to Commercial Transports,[1] by *Philip Donely*, NASA

2 MONDAY, June 6 9:30 a.m.

Space Auxiliary Power—Part 1

Space Missions and Auxiliary Power Demands,[1] by *W. R. Menetrey* and *J. Burns*, Electro-Optical Systems, Inc.

Operation of Rotating Equipment in Zero-Gravity Field,[1] by *K. Trayneliis*, Walter Kidde & Co., Inc.

An Advanced Closed-Cycle Chemical Auxiliary Power Unit for Space Vehicles,[1] by *E. B. Zwick*, Sundstrand Corp.

The Status and Future of Thermionic Energy Conversion,[1] by *N. Rasor*, North American Aviation, Inc.

3 MONDAY, JUNE 6 9:30 a.m.

STOL Aircraft Concepts

Fixed-Wing STOL Aircraft With Distributed Suction Boundary-Layer Control for Extended Latitude,[1] by *J. J. Cornish, III*, Mississippi State Univ.

The Ducted Propeller for STOL Airplanes,[1] by *August Raspet*, Mississippi State Univ.

MONDAY, JUNE 6 9:30 a.m.

Jointly With Human Factors and Human Factors Society

See Human Factors 1

4 MONDAY, JUNE 6 2:30 p.m.

Short Range Rapid Transit—Ground Traffic

Levacars, Why and How?[1] by *A. L. Haynes* and *D. J. Jay*, Ford Motor Co.

Monorail Potential?, by *W. H. T. Holden*, consulting engr., Pasadena, Calif. (Paper No. 60—Av-3)

Urban Transportation for Large Metropolitan Areas,[1] by *R. A. Keith*, National Capital Planning Commission

[1] Paper not available—see box on page 132.

5 MONDAY, JUNE 6 2:30 p.m.

Space Auxiliary Power—Part 2

Recent Advancements in Solar Cell Technology,[1] by *Martin Wolf*, Hoffman Electronics Corp.

An Experimental Sodium Vapor Power Plant,[1] by *J. T. Congelliere*, North American Aviation, Inc.

An Optimized Condensor Radiator for Space Application,[1] by *P. C. Holden* and *F. C. Stump*, Westinghouse Elec. Corp.

Space Electrical Power Application Study,[1] by *N. F. Schuh* and *H. B. Saldin*, Westinghouse Elec. Corp.

The AEC's Program to Meet Space Power Requirements,[1] by *G. M. Anderson*, AEC

6 MONDAY, JUNE 6 2:30 p.m.

Boundary-Layer Control Applications to Mechanical Engineering

High-Efficiency Flow Diffusion by Means of Suction Boundary-Layer Control,[1] by *I Man Moon*, The Johns Hopkins Univ.

Investigation of High-Efficiency Jet Pumps Utilizing Boundary-Layer Control,[1] by *W. G. Wells*, Mississippi State Univ.

Distributed Suction Boundary-Layer Control Applied to Axial Fans,[1] by *E. G. Miles*, U. S. Military Academy

MONDAY, JUNE 6 2:30 p.m.

Jointly With Human Factors and Human Factors Society

See Human Factors 2

7 TUESDAY, JUNE 7 9:30 a.m.

Glass-Reinforced Plastic as an Aviation Gas-Turbine Compressor Housing Material,[1] by *D. R. Fraser*, Westinghouse Elec. Corp.

Maintenance Experience With Boeing Gas Turbines,[1] by *D. F. McGrath*, Boeing Airplane Co.

8 TUESDAY, JUNE 7 9:30 a.m.

Jointly With Human Factors, Midwestern Simulation Council, and Human Factors Society

Simulation of Human Physiological Systems,[1] by *R. W. Stacy* and *N. A. Coulter, Jr.*, Ohio State Univ.

Accomplishments in Human Operator Simulation,[1] by *G. E. Briggs* and *R. Cosgriff*, Ohio State Univ.

Accomplishments in Human Simulation,[1] by *A. B. Clymer*, North American Aviation, Inc.

9 TUESDAY, JUNE 7 9:30 a.m.

Short Range Rapid Transit—Economics

Panel Discussion: Traffic Potential—Air Versus Ground for Intercity, Intracity, and Airport to Downtown

N. S. Simat, United Research Inc.

H. E. Davis, Univ. of California

J. E. Gorham, Stanford Research Inst.

10 TUESDAY, JUNE 7 2:30 p.m.

American Airlines' Experience With Gas-Turbine Engines,[1] by *William Hall*, American Airlines, Inc.

Maintenance on Pipeline Gas Turbines,[1] by *B. J. Matthews*, El Paso Natural Gas Co.

Maintenance Experience of the Bristol Proteus in BOAC's Britannia Aircraft and the Rolls Royce Avon Engine in the Comet Aircraft,[1] by *J. G. Romeril*, BOAC, Hounslow, Middlesex, England

11 TUESDAY, JUNE 7 2:30 p.m.

Jointly With Human Factors, Midwestern Simulation Council, and Human Factors Society

Possibilities for Simulation of Dynamic Physiology,[1] by *A. J. Gold*, Goodyear Aircraft Corp.

Possibilities for Simulation of Human Dynamics and Perception,[1] by *A. J. Cacioppo*, Goodyear Aircraft Corp.

Possibilities for Human Simulation,[1] by *A. B. Clymer*, North American Aviation, Inc., and *A. F. Ax*, Lafayette Clinic; Wayne State Univ.

12 TUESDAY, JUNE 7 2:30 p.m.

On the Use of Simulation Techniques in Bi-Propellant Liquid Rocket-Engine Development,[1] by *J. R. Fenwick*, North American Aviation, Inc.

Performance and Applications of the Ram Rocket,[1] by *R. R. Kassner* and *F. W. Gobets*, North American Aviation, Inc.

13 WEDNESDAY, JUNE 8 9:30 a.m.

Air Force Maintenance on the J-79 Engine,[1] by *R. M. Harrison* and *H. L. Crosley*, Oklahoma City Air Materiel Area Hdqrs.

Maintenance of Simple-Cycle Natural-Gas Burning Gas Turbines During Ten Years' Operation in Utility Service,[1] by *J. W. Blake*, Oklahoma Gas & Elec. Co.

14 WEDNESDAY, JUNE 8 9:30 a.m.

Fast Manned Reconnaissance Mission to Venus and Mars—Part 2, by *K. A. Ehricke*, Convair Astronautics (Paper No. 60—Av-1)

Temperature-Control System for Able-4 Atlas Lunar Satellite,[1] by *R. M. Acker, R. P. Lipkis*, and *J. E. Vehrencamp*, Space Technology Labs., Inc.

Mission and State-of-the-Art Effects on Rocket-Feed System Comparisons,[1] by *J. Jortner* and *J. Rosemary*, North American Aviation, Inc.

15 WEDNESDAY, JUNE 8 9:30 a.m.

Moisture Accumulation in Aircraft Soundproofing and Insulation,[1] by *Jorgen Jensen-Gaard*, Scandinavian Airlines System, Virum, Denmark

Moisture Migration in an Aircraft Cabin Wall,[1] by *F. B. Bjorklund* and *A. C. Watson*, Douglas Aircraft Co., Inc.

The Development of United Air Lines Jet Transport Galleys,[1] by *R. H. Koza* and *R. L. Heinrich*, United Air Lines, Inc.

16 WEDNESDAY, JUNE 8 2:30 p.m.

The FAA Looks at Jet Transport Mechanisms,[1] by *Harold Hoekstra* and *Walter Spelman*, FAA

The DC-8 Seat—Passenger Protection With Structural Economy,[1] by *Jack Madsen*, Douglas Aircraft Co., Inc.

Over-all Braking for Jet Transports,[1] by *D. E. Nichols*, Boeing Airplane Co.

17 WEDNESDAY, JUNE 8 2:30 p.m.

Designing for Reliability and Maintainability—Integrating the Avionics

Modular Design,[1] by *H. L. Dudley* and *A. M. Maher*, Melpar, Inc.

Uniform Design Criteria,[1] by *J. C. Wightman*, Wright-Patterson Air Force Base, Ohio

18 WEDNESDAY, JUNE 8 2:30 p.m.

Jointly with Instruments and Regulators

Determination of the In-Flight Vertical,[1] by *C. E. Barkalow* and *H. C. Daubert, Jr.*, Lear, Inc.

A Self-Stabilizing Gyro Control System for Space Vehicles,[1] by *Sidney Godet*, Reeves Instrument Corp.

Viscous Shear Torque in Floated Gyroscopes,[1] by *J. F. Bellantoni*, Sperry Gyroscope Co.

19 THURSDAY, JUNE 9 9:30 a.m.

Designing for Safety—Applied Loads

The Navy Approach to the Development of Airplane Structural Design Requirements,[1] by *W. H. Keen*, Dept. of the Navy

What the Structural Designer Needs in Design Criteria,[1] by *Robert Goldin*, Bell Aircraft Corp.

Dynamic Loads During Nose-Tow Catapulting,[1] by *Warner Lansing, J. L. Malakoff*, and *W. H. Mueller*, Grumman Aircraft Engrg. Corp.

20 THURSDAY, JUNE 9 9:30 a.m.

Jointly With Instruments and Regulators

Design Considerations for a High-Temperature-Rate Gyroscope,[1] by *P. J. Pijoan* and *J. J. Buckley*, Westinghouse Elec. Corp.

On Eddy Current Damping for Miniature Oscillating Devices,[1] by *R. M. Harrod*, Whittaker Gyro, Div. of Telecomputing Corp.

OFFICIAL NOTICE

ASME Business Meeting

Presiding: *Walker L. Cisler*

Results of Letter-Ballot on Constitution Amendments

Approval of Amendments to By-Laws and Rules

Announcement of Location of 1961 Semi-Annual Meeting

Election of Nominating Committee for 1961

Report on United Engineering Center

Report on Unity of the Engineering Profession

This Business Meeting of the members provides an opportunity for a free discussion of Society policies and procedures. All members are urged to attend.

Adaptive Servo Transducers,[1] by *R. H. Smith, George Messner,* and *Joseph Kukel,* Daystrom, Inc.

21 THURSDAY, JUNE 9 9:30 a.m.

Ground Support Equipment

Development of Preloaded Baggage Systems for Turbine Powered Transports,[1] by *Blaine Blakestad,* American Airlines, Inc.

DC-8 Preloaded Container System,[1] by *D. A. Medland,* United Air Lines, Inc.

Facility-Type Cold-Air Jet Engine Starting Systems,[1] by *E. O. Gibson, Jr.,* Wells Industries Corp.

Jet Engine Starting and Aircraft Pneumatic Servicing With Portable High-Pressure Stored Air Systems Equipment,[1] by *J. J. Kardys,* Accessory Controls & Equipment Corp.

22 THURSDAY, JUNE 9 2:30 p.m.

Designing for Safety—Flight Controls

Safety Considerations in the Design of Flight-Control Systems for Navy Aircraft,[1] by *W. R. Lomas,* U. S. Naval Air Development Center

Air Force Safety Requirements for Flight Controls,[1] by *Richard Hollingsworth,* Wright-Patterson Air Force Base, Ohio

The FAA Looks at Flight Controls,[1] by *E. S. Newberger,* FAA

23 THURSDAY, JUNE 9 2:30 p.m.

A New Fail-Safe Compensated Altimeter,[1] by *Walter Angst* and *James Angus,* Kollsman Instrument Corp.

Barometric Altitude—The Problem, Solution, and Altimeter Design,[1] by *R. A. Cooper,* AiResearch Mfg. Co.

Altimetry—Comparative Merit of Static Pressure Compensating Systems,[1] by *C. E. Johanson,* Bendix Aviation Corp.

24 THURSDAY, JUNE 9 2:30 p.m.

Passenger Handling at the Terminal—Walk or Ride

Passenger Loading Equipment,[1] by *C. L. Lodjic,* Pacific Iron & Steel Corp.

A New Concept for Passenger Handling—The Airport Mobile Lounge,[1] by *J. M. Martin,* Chrysler Corp.

HEAT TRANSFER SESSIONS

1 MONDAY, JUNE 6 2:30 p.m.

A Thermal Study of Composite Heat Sinks,[1] by *J. V. Beck,* AVCO Mfg. Corp.

Temperature Distribution in an Internally Cooled, Heat-Generating Solid, by *E. M. Sparrow,* Univ. of Minnesota (Paper No. 60—SA-15)

[1] Paper not available—see box on page 132.

Transient Heating of Two-Element Slabs Exposed to a Plane Heat Source, by *Henry Halle* and *D. E. Taylor,* The Univ. of Chicago (Paper No. 60—SA-14)

2 TUESDAY, JUNE 7 9:30 a.m.

The Heat Balance Integral—Further Considerations and Refinements, by *T. R. Goodman,* Allied Research Assoc., Inc. (Paper No. 60—SA-9)

Effect of Aspect Ratio and Tube Orientation on Free-Convection Heat Transfer to Water and Mercury in Enclosed Circular Tubes,[1] by *F. W. Larsen,* FluiDyne Engrg. Corp., and *J. P. Hartnett,* Univ. of Minnesota

A Study of Free Convection Boundary-Layer Oscillations and Their Effects on Heat Transfer,[1] by *J. P. Holman,* Southern Methodist Univ., *H. E. Gartrell,* and *E. Soehngen,* Wright-Patterson Air Force Base, Ohio

3 TUESDAY, JUNE 7 2:30 p.m.

Experimental Determination of Limit of Supersaturation of Nitrogen Vapor Expanding in a Nozzle, by *G. L. Goglia,* North Carolina State Coll., and *G. J. Van Wylen,* Univ. of Michigan (Paper No. 60—SA-8)

Some Temperature and Pressure Measurements in Confined Vortex Fields, by *J. M. Savino* and *R. G. Ragsdale,* NASA, Lewis Research Center (Paper No. 60—SA-4)

The Influence of By-Pass Channels on the Laminar Flow Heat-Transfer and Fluid Friction Characteristics of Shell and Tube Heat Exchangers, by *F. L. Test,* Univ. of Rhode Island (Paper No. 60—SA-7)

HUMAN FACTORS SESSIONS

1 MONDAY, JUNE 6 9:30 a.m.

Jointly With Aviation Division and Human Factors Society

The Effect of Scale Form on the Speed and Accuracy of Scale Reading,[1] by *L. E. Wilkerson* and *W. G. Matheny,* Bell Helicopter Corp.

Task Performance With the CRL Model 8 Master-Slave Manipulator as a Function of Color-Coding, Distance, and Practice,[1] by *B. M. Crawford* and *D. F. Baker,* Wright-Patterson Air Force Base, Ohio

Human Factors Evaluation of a Keyset Entry Technique for Frequency and Channel Selection,[1] by *D. E. Page* and *I. A. Goldberg,* ITT Labs.

2 MONDAY, JUNE 6 2:30 p.m.

Jointly With Aviation Division and Human Factors Society

Manual Control of Undamped Systems Subjected to Force-Coupled Accelerations,[1] by *P. R. Knaff,* Gen. Elec. Co.

Control Performance Under Acceleration With Side-Arm Attitude Controllers,[1] by *R. M. Chambers,* U. S. Naval Air Dev. Center

Manual Attitude Control in Space: Arrangement of Controls,[1] by *M. L. Ritchie* and *L. F. Hanes,* Ritchie & Assoc., Inc.

TUESDAY, JUNE 7 9:30 a.m.

Jointly With Aviation Division, Midwestern Simulation Council, and Human Factors Society

See Aviation 8

TUESDAY, JUNE 7 2:30 p.m.

Jointly With Aviation Division, Midwestern Simulation Council, and Human Factors Society

See Aviation 11

INSTRUMENTS AND REGULATORS SESSIONS

WEDNESDAY, JUNE 8 2:30 p.m.

Jointly With Aviation

See Aviation 18

THURSDAY, JUNE 9 9:30 a.m.

Jointly With Aviation

See Aviation 20

[1] Paper not available—see box on page 132.

JUNIOR SESSION

MONDAY, JUNE 6 9:30 a.m.

Panel Session

What Management Expects From the Young Engineer,[2] by *R. B. Gilmore,* DeGolyer & MacNaughten

Recruiting the Graduate Engineer,[2] by *Tom Calvert,* Texas Instruments, Inc.

Evaluation of Military Experience,[2] by *Garland Whisenhunt,* Chance Vought Aircraft, Inc.

Selection of Employer,[2] by *Sid Pitzer,* Sun Oil Co.

Training Programs,[2] by *Carvel Chandler,* Dallas Power & Light Co.

MACHINE DESIGN SESSIONS

1 MONDAY, JUNE 6 9:30 a.m.

Studies of the Design of Steel Castings and Steel Weldments as Related to Methods of Their Manufacture, by *H. R. Nara* and *D. K. Wright, Jr.,* Case Inst. of Tech., and *C. W. Briggs,* Steel Founders' Society of America (Paper No. 60—SA-2)

Photoelastic Model Engineering, by *Herbert Becker* and *George Gerard,* New York Univ. (Paper No. 60—SA-11)

2 MONDAY, JUNE 6 2:30 p.m.

Inspecting Taper Threads—A New Technique, by *A. A. Miltenbergs,* Battelle Memorial Inst., and *Ned Rodgers,* American Iron & Machine Works Co. (Paper No. 60—SA-6)

Design of Flapper Valves, by *P. R. Paslay,* The Rice Inst. (Paper No. 60—SA-3)

Two-Stage Planetary Arrangements for the 15:1 Turboprop Reduction Gear, by *E. A. Brass,* AVCO Corp. (Paper No. 60—SA-1)

3 TUESDAY, JUNE 7 9:30 a.m.

On the Use of Clearance in Viscous Dampers to Limit High-Frequency Force Transmission,[3] by *M. E. Gurtin,* Brown Univ. (Paper No. 60—SA-17)

Analysis and Design of Tangent Elasticity Vibration Isolators,[3] by *J. E. Rusicka,* Barry Controls Inc. (Paper No. 60—SA-5)

The Vibration of Shaft Ropes With Time-Variable Length, Treated by Means of Riemann's Method, by *W. J. Schaffers,* E. I. du Pont de Nemours & Co., Inc. (Paper No. 60—SA-16)

Analysis of Buckling Column Spring With Pivoted Ends and Uniform Rectangular Cross Section, by *Alexander Blake,* Associated Spring Corp. (Paper No. 60—SA-10)

MANAGEMENT SESSIONS

1 TUESDAY, JUNE 7 9:30 a.m.

Personnel Problems in the '60's—Understanding Human Behavior,[3] by *L. F. Hackemann,* Hackemann & Assoc.

L TUESDAY, JUNE 7 12:15 p.m.

Management Luncheon

Speaker: *W. W. Finlay,* Antioch College, Yellow Springs, Ohio

Subject: **Education for Management—A New Challenge of the Sixties**

2 TUESDAY, JUNE 7 2:30 p.m.

Understanding the Creative Engineer,[1] by *H. R. Buhl,* Iowa State Univ.

Managing the Professional Employee,[1] by *W. J. Jaffe,* Newark Coll. of Engrg.

Motivating Subordinates to High Performance,[1] by *D. R. Yarnall, Jr.,* Yarnall-Waring Co.

3 WEDNESDAY, JUNE 8 9:30 a.m.

A New Approach to Engineering Personnel Evaluation in a Large Organization,[1] by *K. D. Holland,* consulting mech. engr., Pacific Palisades, Calif.

What Can an Engineer Do to Break the Communication Barrier?[1] by *E. J. De Witt,* Wallace Supplies Mfg. Co.

[1] Paper not available—see box on page 132.
[2] Not presented orally.
[3] Not to be printed.

A Method for Determining the Optimum Starting Quantity When Manufacturing to Fixed-Order Size,[1] by *H. P. Goode* and *Sidney Saltsman*, Cornell Univ.

MATERIALS HANDLING SESSION

THURSDAY, JUNE 9 9:30 a.m.

Packaging and Handling of Precision Instruments,[1] by *Arthur Bleimeyer, Jr.*, W-K-M Div. of ACF Industries, Inc.

Material Handling in Maintenance Work,[1] by *Jodie Isenhower*, Humble Oil & Refining Co.

Cargo Handling,[1] by *E. C. Mitchell*, Un.ted Air Lines, Inc.

MIDWESTERN SIMULATION COUNCIL SESSIONS

TUESDAY, JUNE 7 9:30 a.m.

Jointly With Aviation, Human Factors, and Human Factors Society

See Aviation 8

TUESDAY, JUNE 7 2:30 p.m.

Jointly With Aviation, Human Factors, and Human Factors Society

See Aviation 11

NUCLEAR ENGINEERING SESSION

MONDAY, JUNE 6 9:30 a.m.

Panel Session

The C Stellerator for Fusion Power,[2] by *L. J. Linde*, Allis-Chalmers Mfg. Co.

The Possibility of Power Recovery From Nuclear Explosions,[2] by *J. F. Tracy*, Univ. of California

Oil Production From Nuclear Explosions,[2] by *Milo Nordyke*, Univ. of California

PETROLEUM SESSIONS

1 WEDNESDAY, JUNE 8 9:30 a.m.

The Development of a Continuous Fluid-Density Measuring Device,[1] by *G. V. Copland*, Halliburton Oil Well Cementing Co.

A Floating Vessel Drilling and Completion Method,[1] by *David Guinn* and *Roy Walker*, Shaffer Tool Works

[1] Paper not available—see box on page 132.
[2] Not to be printed.

Are You Going?

ARE you interested in attending the International Congress of Applied Mechanics in Stresa, Italy, Aug. 31–Sept. 10, 1960?

The ASME Applied Mechanics Division Executive Committee is considering plans for a group of at least 70 or charter with a scheduled commercial airline that will provide substantial savings to ASME members planning to attend the Congress.

If you are interested, write promptly to T. A. Marshall, Jr., Senior Assistant Secretary, ASME, 29 West 39th St., New York 18, N. Y.

Open Hearings for ASME National Nominations

THE 1960 Nominating Committee is to meet June 6–7, 1960, at the Statler-Hilton Hotel in Dallas, Texas, during the Semi-Annual Meeting. The Nominating Committee has scheduled open hearings so that members may speak in behalf of candidates for the office of President, Regional Vice-Presidents, and Directors. The schedule of these meetings will be:

Monday, June 6	10:00 a.m. to 12:00 noon 2:00 p.m. to 5:00 p.m.
Tuesday, June 7 (if necessary)	9:00 a.m. to 12:00 noon 2:00 p.m. to 4:00 p.m.

L WEDNESDAY, JUNE 8 12:15 p.m.

Petroleum Luncheon

Presider: *J. P. Mooney*, Humble Oil & Refining Company, Baytown, Texas

Speaker: *Martin Goland*, Southwest Research Institute, San Antonio, Texas

Subject: **Beyond the Captured Territory**

2 WEDNESDAY, JUNE 8 2:30 p.m.

Stresses in Thin-Walled Pressure Vessels With Ellipsoidal Heads, by *Harry Kraus*, Westinghouse Elec. Corp., *G. G. Bilodeau*, Sylvania Electronic Systems, and *B. F. Langer*, Westinghouse Elec. Corp. (Paper No. 60—SA-12)

An Analysis of the Yielded Compound Cylinder, by *S. J. Becker*, Westinghouse Elec. Corp. (Paper No. 60—SA-13)

PROCESS INDUSTRIES SESSIONS

1 WEDNESDAY, JUNE 8 2:30 p.m.

Status of Saline Water Conversion and Its Economic Importance,[1] by *S. T. Powell* and *E. L. Knoedler*, Sheppard T. Powell & Assoc.

Saline Water Conversion and the Demonstration Program,[1] by *Allen Cywin*, U. S. Dept. of the Interior

Development of a Prototype for a Large Electrodialysis Cell for Treating Brackish Waters,[1] by *H. R. Drew*, Texas Elec. Service Co.

2 THURSDAY, JUNE 9 9:30 a.m.

Toward Resolution of the Chaos and Confusion in Our System of Units,[1] by *C. F. Kayan*, Columbia Univ.

Logical Automation of a Polymerization Reactor,[1] by *E. R. Forman* and *Robert Lesse*, Catalytic Construction Co.

The Free Expansion of Dry and Moist Air,[1] by *J. H. Potter*, Stevens Inst. of Tech. and *Martin Levy*, Newark Coll. of Engrg.

PROFESSIONAL PRACTICE COMMITTEE SESSION

TUESDAY, JUNE 7 2:30 p.m.

Panel Discussion: The Conflict of Interests as Exemplified by the Furnishing of Free Engineering by Manufacturers

STUDENT MEMBER COMPETITION

1960 OLD GUARD PRIZE

1 WEDNESDAY, JUNE 8 9:30 a.m.

To help the young engineer bridge the gap between college and professional life is the aim of the Old Guard Committee—organized 23 years ago to administer the voluntary contributions of many Dues Exempt Members. These funds provide travel expense to selected Student Members and Junior Associate Members for attendance at national and regional meetings, and to assist the National Junior Committee in various activities. A high light of the Old Guard program is a national Papers Contest which is held each year at the Semi-Annual Meeting of the Society. The First Prize winners of the competitions in the 12 annual Regional Student Conferences are invited to participate in this event as guests of the Old Guard. The Student Member judged to have presented the best paper will be awarded $150. In addition, he will receive an expense-paid trip to the Annual Meeting, this year in New York City, where he will re-present his paper before the Society members and receive his award from the President of the ASME.

The names of six winners from Regional Student Conferences will appear in the final program after selection has been determined at conclusion of the last scheduled Student Conference on May 6–7, 1960.

2 WEDNESDAY, JUNE 8 2:30 p.m.

The names of six additional winners from Regional Student Conferences will appear in the final program after selection has been determined at conclusion of the last scheduled Student Conference, May 6–7, 1960.

ASME Boiler and Pressure Vessel Committee to Hold 1960 Out-of-Town Meeting in Denver

THE Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers holds six meetings a year; one of which is held outside of New York City. The 1960 meeting will be held jointly with The National Board of Boiler and Pressure Vessel Inspectors at the Brown Palace Hotel, Denver, Colo., from April 24 to April 29, 1960, inclusive.

Meetings will be held of the various subcommittees covering, in part, power, fire-tube, and heating boilers as well as unfired pressure vessels. The National Board of Boiler and Pressure Vessel Inspectors also will hold sessions at this meeting. There will be addresses by the various state and city representatives. A banquet is scheduled for Wednesday evening.

The all-day session of the Boiler and Pressure Vessel Committee is planned for Friday. Meetings of the various subcommittees as well as the Boiler and Pressure Vessel Committee are open to the public.

Representatives from the Boiler and Pressure Vessel Committee and The National Board of Boiler and Pressure Vessel Inspectors as well as ASME Region VIII comprise the Planning Committee.

1960 ASME Design Engineering Conference and Design Engineering Show at New York Coliseum, May 23–26

- Atomic and space research leaders to discuss applications of latest findings to everyday production
- The show offers demonstration and information on year's most important developments, performance comparison, and sacks of samples for later testing

PAST attendance records—20,000 engineering and management leaders—prove that the Design Engineering Conference, sponsored by the Machine Design Division of The American Society of Mechanical Engineers, and the Design Engineering Show, produced by the exposition management firm of Clapp & Poliak, Inc., of New York City, together, are a must that men engaged in the field cannot afford to miss.

The technical sessions are held in the morning, starting at 9:30 a.m., and the show in the afternoon, opening at noon. One does not conflict with the other.

The Show

The Design Engineering Show brings together in one place, at one time, the year's most important developments from some 400 manufacturers. Products, processes, and services that directly affect the work in this field and the progress of companies are demonstrated so that performances may be compared on the spot. Samples are plentiful so that more comprehension tests can be made at laboratories at home.

Four hundred top-notch exhibitors will present mechanical, electrical, and electronic components, metals, nonmetallic materials, fasteners, finishes and coatings, shapes and forms, hydraulic and pneumatic components, power transmission, research and testing equipment, engineering equipment, and services. Spread out over four floors of New York's Coliseum will be a complete range of materials and components for product design and development.

If you create new products, redesign existing ones, or supervise those who do —you will want to attend the 1960 Design Engineering Show.

The Conference

New Horizons in Engineering Design—theme of the Design Engineering Conference—will be developed in the following technical program.

▶ MONDAY, MAY 23 **9:45 a.m.**

New Horizons in Engineering Design

A panel of design authorities will, by brief talks and answers to questions, show how new design principles, relationships, and formulas developed specifically for their fields of nuclear and space technology can be applied to develop better designs of commercial products. Included will be the applications of materials and components to meet extremes of environmental conditions and to achieve the ultimate in performance.

High and low temperatures, erosion, corrosion, impact, vibration, miniaturization, reliability, and limited life will be among the items discussed.

Co-chairmen: *Hugh L. Dryden*, Deputy Administrator, National Aeronautics and Space Administration, Washington, D. C.; *Arthur R. Kantrowitz*, director, Avco-Everett Research Laboratory, Div. of Avco Corp., Everett, Mass.

Panel Members

William R. Gall, chief of Design Section, Reactor Experimental Engineering Div., Oak Ridge National Laboratory, Oak Ridge, Tenn.

Varick D. Schwartz, assistant project manager, Army Boiling Water Reactor Project, Combustion Engineering, Inc., Windsor, Conn.

George P. Sutton, chief scientist, Advanced Research Projects Agency, Department of Defense, Washington, D. C.

Elmer P. Wheaton, vice-president—engineering, Missiles and Space Systems, Douglas Aircraft Co., Inc., Santa Monica, Calif.

▶ TUESDAY, MAY 24 **9:30 a.m.**

Reliability

Reliability now is recognized as being a physical phenomenon which is basically a design problem. Methods and interpretation of answers to reliability predictions will be discussed, as well as the meaning of reliability requirements in equipment specifications, and the types of special design techniques which can be used to meet these requirements.

Co-chairmen: *Frank McGinnis*, director, Reliability and Quality Control, Sperry Gyroscope Co., Div. of Sperry-Rand, Great Neck, N. Y.; *Nicholas Osifchin*, military development engineer, Bell Telephone Laboratories, Inc., Whippany, N. J.

Reliability Prediction as a Design Tool, by *T. C. Reeves*, director of Product Assurance, RCA Defense Electronic Products Div., New York, N. Y., (Paper No. 60—MD-1)

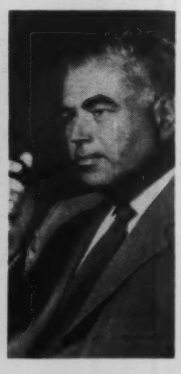
Impact of Reliability on Design, by *H. R. Powell*, member of Senior Staff, Space Technology Laboratories, Los Angeles Calif. (Paper No. 60—MD-2)

Fabrication

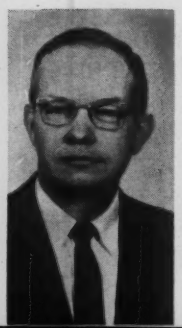
In the joining and forming of metal parts many new processes have been developed in the past few years. Papers will cover areas where the newer methods overlap or replace the older processes and

Dryden

Kantrowitz



Gall



Schwartz

Sutton

Wheaton

indicate the areas where the newer methods have distinct advantages. Tolerances, quality, and solutions to problems will be stressed.

Co-chairmen: *H. R. Bullock*, senior engineer, Metallurgical Laboratory, Government Equipment Div., Raytheon Co., Maynard, Mass.; *John Alico*, manager, New York Office, Day and Zimmermann, New York, N. Y.

New Welding Processes, by *J. J. Chyle*, director of Welding Research, A. O. Smith Corp., Milwaukee, Wis. (Paper No. 60—MD-3)

Metal-Part Fabrication by Explosives, by *Vasil Philipchuk*, manager, Special Projects Dept., National Northern Div., American Potash & Chemical Corp., West Hanover, Mass. (Paper No. 60—MD-4)

Hydraulics

Emphasis will be on the "extreme-service frontier" for components, fluids, and seals used in ground equipment, aircraft, space vehicles, and nuclear power units. Extreme pressure, temperature, reliability, capacity/weight ratio, and other salient points will be covered, as well as possible trends and improvements.

Co-chairmen: *E. M. Greer*, president, Greer Hydraulics, Inc., New York International Airport, Jamaica, N. Y.; *J. A. Farris*, manager, Engineering Liaison, Aircraft Porous Media, Inc., Pall Corp., Glen Cove, N. Y.

Trends and Factors Influencing Hydraulics, by *Edward Brown*, director of engineering, Machinery Hydraulic Div., Vickers, Inc., Detroit, Mich. (Paper No. 60—MD-5)

Hydraulic Fluids—Today and Tomorrow, by *R. L. Leslie*, supervisor, Fluids and Chemistry Group, Research and Development Dept., Vickers, Inc., Detroit, Mich. (Paper No. 60—MD-6)

▶ WEDNESDAY, MAY 25 9:30 a.m.

Control Systems

Computers have a twofold use in the control field: one, to design the control system based on the known variables as indicated by an analog unit; and, two, as part of the control system to maintain process or control function. Papers will cover the main engineering problems associated with these computer uses.

Co-chairmen: *E. L. Harder*, director, Analytical Dept., Westinghouse Elec. Corp., East Pittsburgh, Pa., and *J. T. Lynch*, manager, Electronic Dept., Burroughs Corp., Paoli, Pa.

Analysis of Control Systems by Analog Computers, by *W. E. Sollecito*, systems analysis engineer, General Engineering Laboratory, Gen. Elec. Co., Schenectady, N. Y. (Paper No. 60—MD-7)

Computers in Control Systems, by *A. S. Robinson*, assistant chief engineer for advance electronic research and development, Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J. (Paper No. 60—MD-8)

Materials

High-strength steels and composite materials are being used in more applications than ever before, but they present problems in processing and selection. Papers present properties, available forms, and illustrate applications, as well as give an approach to obtain optimum characteristics.

Co-chairmen: *Albert R. Mead*, staff engineer, Manufacturing Engineering Dept., Grumman Aircraft Engineering Corp., Bethpage, N. Y., and *Edward N. Hegge*, Deputy Director, Watertown Arsenal Laboratories, U. S. Army Ordnance Arsenal, Watertown, Mass.

Some Considerations in the Use of High-Strength Steels, by *A. M. Hall*, division chief, Battelle Memorial Inst., Columbus, Ohio (Paper No. 60—MD-9)

Increasing the Performance of Nonmetallic Structural Materials, by *W. E. Dirkes*, chief, Plastics Branch, Materials Laboratory, Wright Air Development Center, Wright-Patterson Field, Ohio (Paper No. 60—MD-10)

Automation

More errors are made in designing for automatic assembly because parts are not designed with the method in mind. Papers will cover the design recommendations for miniature and subminiature components to give ease of assembly, and product design do's and don'ts to facilitate economic and practical assembly.

Co-chairmen: *George F. Hawley*, director of development and engineering, Automation Engineering Laboratory, Inc., Stamford and Greenwich, Conn., and *Allan Harvey*, president, Dasol Corp., New York, N. Y.

Concept of Modular Design for Mechanized Assembly, by *A. A. Lawson*, consulting project engineer, Melpar, Inc., Falls Church, Va. (Paper No. 60—MD-11)

Basic Design Parameters for Automatic Assembly, by *Robert Esken*, supervisor, engineering and sales application, Autometrology Section, Sheffield Corp., Dayton, Ohio (Paper No. 60—MD-12)

▶ THURSDAY, MAY 26 9:30 a.m.

Use of Computers in Design

Panel of computer users who have had the problems of scheduling and integrating their computer sections into the over-all engineering setup. They will discuss and answer questions on: Types of design problems that can be computer solved; types of computers to use; training of personnel; costs of installations and operations.

Co-Chairmen: *Julius S. Aronofsky*, manager, Electronic Computer Center, Socony-Mobil Oil Co., Inc., New York, N. Y., and *Raymond Payne*, supervisor, Engineering Computer Section, Worthington Corp., Harrison, N. J.

Panel Members

E. F. Magnusson, mathematician, Control Programming, General Engineering Laboratory, Gen. Elec. Co., Schenectady, N. Y.

George Ryckman, supervisor, data processing group, General Motors Research Corp., General Motors Corp., Detroit, Mich.

Aaron Finerman, manager, Digital Computing and Data Processing Div., Republic Aviation Corp., Farmingdale, N. Y.

J. A. Hrones Urges Development of Automatic Controls in Clayton Lecture

THE world's need for developing automatic controls to replace human energy places heavy demands upon modern engineering education, John A. Hrones, Mem. ASME, vice-president for Academic Affairs of Case Institute of Technology, declared in a speech he delivered recently in London, England.

As the James Clayton lecturer before The Institution of Mechanical Engineers, Dr. Hrones traced the history of automatic controls and outlined their great potential for maintaining a position of influence for the western world.

Leadership of the Highest Caliber. He said, "The world sadly needs leadership of the highest caliber. To provide this we must relieve the able human mind of all tasks which can be handled in some other fashion. More and more we are moving into a society where man's efforts are spent in controlling the distribution and utilization of power and relatively little energy is directly supplied by man."

"If the western world is to maintain a position of influence and to continue its traditional support of individual freedom, talented men must be used to their fullest capacity in situations where judgment, wisdom, and creativity are indispensable. We must therefore continue to develop our understanding of control phenomena."

In discussing the future of automatic control, Dr. Hrones stressed the importance of design. He said, "Design in the sense that I use it is the creation of something which did not previously exist. It is a total job from conception—through detailed delineation—to successful operation. Design in its fullest meaning is the top role of the engineer."

Engineering Education. One of the handicaps to effective leadership in engineering cited by Dr. Hrones is the traditional barriers that exist between

1960 RAC Meetings Schedule

Date	Days	Location	Hotel	Region	Host Section
April 1–2	Fri-Sat	Los Angeles, Calif.	Disneyland	VII	Los Angeles
April 9–10	Sat-Sun	Columbia, S. C.	Columbia	IV	CSRA
April 11–12	Mon-Tue	Syracuse, N. Y.	Syracuse	III	Syracuse
April 20–21	Wed-Thur	Mexico, D. F.	Continental Hilton	VIII	Mexico
April 25–26	Mon-Tue	Cincinnati, Ohio	Carrousel	V	Cincinnati
April 29–30	Fri-Sat	Minneapolis, Minn.	Normandy	VI	Minnesota
May 2–3	Mon-Tue	Southampton, L. I.	*Scotch Mist Inn	II	Metropolitan
May 6–7	Fri-Sat	New London, Conn.	Mohican	I	New London

Palm Sunday April 10; Good Friday April 15; Easter Sunday April 17

* Note change in location and hotel, Region II, RAC Meeting.

one brand of engineering and another. To overcome this, there is an urgent need for engineers who can deal with complex problems involving many disciplines. Several institutions in the United States have turned their attention to this urgent problem of engineering education.

Dr. Hrones said, "At both Case Institute of Technology and the Massachusetts Institute of Technology, research and design activities and control systems have led to the establishment in interdepartmental laboratories attracting faculty and students from mechanical engineering, electrical engineering, from the management school, and from mathematics.

"At Case, in addition to the Systems Engineering Center, we have organized at the graduate level an Engineering Design Laboratory, a center for Urban and Regional Planning, and are moving toward the establishment of a Center for the Study of Matter. All of these groups draw personnel from a number of different departments. All have the common element of being centers for professional investigations and developments of a challenging nature which require knowledge and understanding in more than one of the traditional fields of engineering and science. In addition to great emphasis on the development of analytic skills there is being developed a continuous stream of design throughout the entire educational program at Case. Imaginatively executed and sparked by the presence of outstanding design work, this element is the feature which clearly distinguishes the role of the engineer from that of the scientist."

"In the design of such systems as have been discussed in this paper, the engineer must be able to cope with electrical as well as mechanical phenomena. He must utilize the most powerful tools of computation as they may be required. This is a large order. It requires an extended program of graduate work and associations with faculty members who are engaged in actual design work of the very broadest and imaginative nature."

"It requires a continuing alertness to the rapidly occurring developments in science and technology and the willingness to move swiftly to make the changes in our educational and professional structure."

Oil and Gas Power Conference and Exhibit, May 22–26, in Kansas City, Mo.

"Economics of Engine Power" is the theme of the thirty-second annual Oil and Gas Power Conference and Exhibit which will be held at the Hotel Muehlebach in Kansas City, Mo., May 22–26, sponsored by the Oil and Gas Power Division of The American Society of Mechanical Engineers with the cooperation of the Kansas City Section.

A feature of the Conference is the Exhibit at which manufacturers in the Oil and Gas Power field display their products and recent developments. By attending the exhibit as well as the conference a person can obtain up-to-date information about the products in which he is interested and also make worthwhile contacts with the representatives of the exhibitors. For the technical sessions a strong effort is being made to insure that the latest advances in Oil and Gas Power are discussed.

In addition to the six technical sessions there will be a dinner address by ASME President Walker L. Cisler on "The Human Side of Energy Fuel," and an address of welcome by L. A. Platt, Chairman of the Kansas City Section; also, several special events are planned. These will include a party given by the host section, Kansas City, to provide entertainment and thrilling games of chance. A trip to TWA Overhaul Base is scheduled. All are invited to see repair, overhaul, assembly, and testing at TWA —one of the largest facilities of its kind in the world. Also, a Kansas City Baseball Party is planned. The game will include the Kansas City Athletics versus the Boston Red Sox at the Kansas City Municipal Stadium.

The women's program for the conference will include tours to Hallmark Cards, Kansas City Wellesley Club Garden, and the Harry S. Truman Library at Independence, Mo. In addition, a basket luncheon in the Garden Center of Loose Park is planned. There also will be shopping in the immediate vicinity of the hotel.

Beautifully landscaped square in heart of downtown Kansas City, Mo., is actually Auditorium Plaza Garage. It provides parking spaces in three underground levels for 1200 cars. This and many more points of interest are to be seen during ASME Oil and Gas Power Conference and Exhibit to be held at Hotel Muehlebach, May 22–26, 1960.

▶ MONDAY, MAY 23

Session 1 **9:30 a.m.**

Horsepower to Heat the Nation, by *R. S. Jefferies*, N. Y. State Natural Gas Corp., Pittsburgh, Pa. (Paper No. 60—OGP-3)

Session 2 **2:00 p.m.**

Internal-Combustion Engines in Steam-Power Stations, by *G. C. Boyer*, Universal Engineering Co., McPherson, Kan. (Paper No. 60—OGP-1)

What's New

Moderator: *John E. Onnen*, Koppers Co., Chicago, Ill.
Three-minute briefs of new developments in the industry by representatives of exhibiting manufacturers.

▶ TUESDAY, MAY 24

Session 3 — **9:00 a.m.**

Nozzle Design Cuts Locomotive Fuel Costs, by *W. J. Gewinner*, American Bosch Division, American Bosch Arma Corp., Springfield, Mass. (Paper No. 60—OGP-9)

Design and Development of Turbochargers for the General Motors Corporation Series 567 Engines, by *A. N. Addie*, Gen. Motors Corp., La Grange, Ill. (Paper No. 60—OGP-7)

Piston-Ring Design and Application Practice for Modern Large Bore Diesel and Gas Engines, by *F. A. Robbins* and *J. W. Lippert*, Koppers Co., Baltimore, Md. (Paper No. 60—OGP-6)

▶ WEDNESDAY, MAY 25

Session 4 — **9:00 a.m.**

Cost Comparisons—Diesel and Steam, by *S. K. Fosholt*, Stanley Engng. Co., Muscatine, Iowa (Paper No. 60—OGP-2)

Power-Cost Studies for Systems With Diesel Generating Stations,[1] by *W. W. Reed*, U. S. Dept. of Agriculture, Washington, D. C.

Session 5 — **2:00 p.m.**

A Laboratory Gas-Engine Lubricant Study, by *P. M. Coant* and *L. W. Manley*, Socony Mobil Oil Co., Paulsboro, N. J. (Paper No. 60—OGP-8)

[1] Paper not available—see box on this page.

Panel Discussion — **2:45 p.m.**

Preventive Maintenance of Internal-Combustion Engines by Spectographic Analysis

Moderator: *H. R. Sennstrom*, American Bosch Arma Corp., Springfield, Mass.

Panel Members

J. W. Barna, Union Carbide and Chemical Co., South Charleston, W. Va.

A. C. Davis, Standard Oil Co. of Indiana, Chicago, Ill.

Ray McBrian, Denver and Rio Grande Western RR Co., Denver, Colo.

E. A. Wells, Gulf Research and Development Co., Pittsburgh, Pa.

▶ THURSDAY, MAY 26

Session 6 — **9:00 a.m.**

System Stability Analysis Including Governor, Engine, Generator, and Tie-Line Impedance, by *L. T. Brinson*, Nordberg Mfg. Co., Milwaukee, Wis.; *George Parker*, Woodward Governor Co., Rockford, Ill.; and *F. S. Rothe*, Gen. Elec. Co., Schenectady, N. Y. (Paper No. 60—OGP-10)

Development of a Speed and Load Sensing Governor, by *G. W. Taylor*, Woodward Governor Co., Rockford, Ill. (Paper No. 60—OGP-4)

Application and Range of the Tuned Housing Vibration Damper, by *E. A. Moorehead*, The Cooper-Bessemer Corp., Mount Vernon, Ohio (Paper No. 60—OGP-5)

Availability of Papers

ONLY numbered ASME papers in this program are available in separate copy form until March 1, 1961. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 40 cents to members of ASME, 80 cents to nonmembers. Payment may be made by check, U. S. Postage Stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten, are $3 to members; $6 to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the July issue of MECHANICAL ENGINEERING containing an account of the conference.

ASME Production Conference to Be Held in Milwaukee; ASTME-MSPME to Co-operate

ON MAY 17–19, 1960, the Production Engineering Division of The American Society of Mechanical Engineers with the co-operation of the ASME Milwaukee Section, The American Society of Tool and Manufacturing Engineers Milwaukee Chapter, and the Milwaukee Society of Production and Methods Engineers will sponsor a conference to be held at the Schroeder Hotel in Milwaukee, Wis. The conference theme is "Improving Productivity." Such topics as Metal Processing Literature, New Methods of Material Handling, Automation, New Forming Methods, Computers and Numerical Control, New Machining Processes, Computers and Production Engineering, and Machine Tool Vibration will be discussed.

Some high lights of the conference will include touring the Pabst and Miller Brewing Companies. At the Productivity Luncheon, Prof. Seymour Melman of Columbia University will speak on the "Problems of Increasing Productivity in the Machinery Producing Industries." Singleton, senior vice-president of Allis-Chalmers Manufacturing Company, will speak at the Banquet on "The Challenging Sixties."

The women attending the conference can enjoy such features as a trip to the Memorial Building Antique Car Museum with a luncheon at a chalet on the shores of Lake Michigan, also a card party and a farewell luncheon get-together with old and new friends.

▶ TUESDAY, MAY 17

Session 1 — **9:30 a.m.**

General Session

Improving Productivity—The Great Commitment,[1] by *Karl Bostrom*, Bostrom Corp., Milwaukee, Wis.

Toshiba in Progress (a film illustrating sophistication of the facilities, craftsmanship, and wide-range of products of the Tokyo-Shibura Company, Japan). Presented, courtesy of the Gen. Elec. Co.

Total Productivity—Motivation and Calibration,[1] by *Joseph Surmacz*, Harnischfeger Corp., Milwaukee, Wis.

Session 2 — **1:30 p.m.**

1959 Review of Metal-Processing Literature

Metal Cutting Analysis,[1] by *J. S. Campbell, R. S. Hahn*, Heald Machine Co., Worcester, Mass.; *J. M. Galimberti*, Kennametal, Latrobe, Pa.; *S. Kobayashi* and *E. J. Thompsen*, Univ. of California, Los Angeles, Calif.

Plastic Working of Metals,[1] by *F. W. Boulger*, Battelle Memorial Inst., Columbus, Ohio

Grinding,[1] by *G. S. Reichenback*, Mass. Inst. Tech., Cambridge, Mass.

Cutting Fluids,[1] by *P. A. Smith*, Mass. Inst. Tech., Cambridge, Mass., and *C. A. Sluhan*, Master Chemical Corp., Toledo, Ohio

[1] Paper not available—see box on this page.

Session 3 — **1:30 p.m.**

New Methods of Materials Handling

Cost Reduction Through Unitization of Work in Process, Raw Materials, and Finished Goods,[1] by *John Bates*, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Methods to Employ Unitization in Your Plant,[1] by *John Bates*, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Automatic Assembly Machines—Standardized for Today's Production,[1] by *Arthur Wiese*, Gilman Engng. and Mfg. Co., Janesville, Wis.

Panel Discussion: New Ideas and Developments in Materials Handling
Panel Members

I. M. Footlik, I. M. Footlik Associates, Skokie, Ill.
W. Brager, Oscar Mayer Co., Madison, Wis.
John Bates, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
A. Wiese, Gilman Engng. and Mfg. Co., Janesville, Wis.

▶ WEDNESDAY, MAY 18

Session 4 — **9:00 a.m.**

Automation

Three Axes Numerical Control of Precision Boring Machine,[1] by *C. R. Hibbard*, Fosdick Machine Tool Co., Cincinnati, Ohio

Located at the start of picturesque Lincoln Memorial Drive this imposing monument to Milwaukeeans killed in World War II and the Korean conflict, is an architectural masterpiece. Built entirely with funds donated by citizens of Milwaukee, the beautiful building contains a community art center and has assembly facilities. It was completed in 1957. See it when you are in Milwaukee for the 1960 Production Engineering Conference, May 17–19, at the Schroeder Hotel.

Transactions Quarterlies: Changes

AFTER a year's experience with the new ASME Transactions quarterlies, it has become necessary to reconsider the assignment of Hydraulic Division papers. Since the Hydraulic Division has been assigned to the *Journal of Basic Engineering*, all hydraulic papers have appeared in this quarterly. However, certain Hydraulic Division papers seem better suited for publication in the *Journal of Engineering for Power*.

Henceforth, papers dealing with prime movers, pumping machinery, compressors, and fluid power systems will, in most cases, be assigned to the *Journal of Engineering for Power*. Papers on water hammer, cavitation, and fluid mechanics will, in general, be assigned to the *Journal of Basic Engineering*.—EDITOR.

The Simultaneous Development of Machinery and Tools,[1] by *R. K. Sedgwick*, Kearney & Trecker Co., Milwaukee, Wis.

Mathematical Methods for Analysis of Capital Equipment,[1] by *J. F. Fowler*, Falk Corp., Milwaukee, Wis.

Session 5 — **9:00 a.m.**

New Forming Methods

On the Analysis of Random Errors on Precision Grinding, by *R. S. Hahn*, Heald Machine Co., Worcester, Mass. (Paper No. 60—Prod-7)

A New Test Method for Determination of Spinability of Metals, by *R. L. Kegg*, research engineer, Cincinnati, Ohio (Paper No. 60—Prod-3)

On the Machining of Shear Spinning, by *Serope Kalpakcioglu*, Cincinnati Milling Machine Co., Cincinnati, Ohio (Paper No. 60—Prod-1)

Session 6 — **2:00 p.m.**

Computers and Numerical Control

Automatic Data Processing for Numerically Controlled Machine Tools,[1] by *C. G. Feldmann*, Mass. Inst. Tech., Cambridge, Mass.

Prognostication on Numerical Control,[1] by *Robert Chamberlin*, Giddings & Lewis Co., Fon du Lac, Wis.

Some Tool Problems in Numerical Control,[1] by *Riley Kuehn*, Boeing Airplane Co., Seattle, Wash.

Milling Cutter Profile Calculation Eliminates Trial Cuts of Helical Parts,[1] by *E. C. Varnum*, Barber-Colman Co., Rockford, Ill.

Session 7 — **2:00 p.m.**

New Machining Processes

Free Machining Steel, Part 1—Tool-Life Characteristics of Resulfurized Steel, by *M. C. Shaw, N. H. Cook*, and *P. A. Smith*, Mass. Inst. Tech, Cambridge, Mass. (Paper No. 60—Prod-2)

Part 2—Tool Life Characteristics of Leaded Steel, *by M. C. Shaw, N. H. Cook*, and *P. A. Smith*, Mass. Inst. Tech., Cambridge, Mass. (Paper No. 60—Prod-4)

Machineability of Nodular Cast Iron—Part 1—Tool Forces and Flank Adhesion, by *I. Ham, K. Hitomi*, and *G. L. Thuering*, Pennsylvania State Univ., University Park, Pa. (Paper No. 60—Prod-8)

A Milling Torquemeter Planetary-Gear Design and Milling Forces Measured With a Planetary-Gear Torquemeter, by *J. R. Roubik*, Kearney-Trecker, Milwaukee, Wis. (Paper No. 60—Prod-5)

▶ THURSDAY, MAY 19

Session 8 — **9:00 a.m.**

Computers and Production Engineering

Operations Research and Production Engineering,[1] by *R. V. Evans*, Univ. of Michigan, Ann Arbor, Mich.

Experience With Practical Operations Research at Allis-Chalmers Manufacturing Company,[1] by *Rene Elecano*, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Digital Computer Method of Assembly-Line Balancing,[1] by *T. R. Hoffman*, Univ. of Wisconsin, Madison, Wis.

An Investigation of a Complex Production Decision Making Problem Utilizing the MISTIC Computer,[1] by *W. P. Smith*, Michigan State Univ., East Lansing, Mich.

Session 9 — **9:00 a.m.**

Machine-Tool Vibration

Rigidity and Stability of Machine Tools,[1] by *M. Sadowy*, Marquette Univ., Milwaukee, Wis.

Some Physiological Effects of Low-Frequency High-Amplitude Vibration,[1] by *M. A. Schmitz* and *C. A. Boettcher*, Bostrom Research Lab., Milwaukee, Wis.

ASME Mid-Continent Section Luncheons Win Crowds

THE HIGH INTEREST in the petroleum industry and the continuing need for expert advice has sparked the Mid-Continent Section of The American Society of Mechanical Engineers to sponsor a series of four forum luncheons during the fall and winter of 1959–1960 at which widely known authorities from throughout the nation were invited to speak. Through the efforts of the Mid-Continent Section in creating a Petroleum Activities Committee, these experts brought to Tulsa's engineers and executives the latest thinking on some of the major problems facing engineers in the petroleum industry. The luncheons were exceptionally well received and attracted large audiences.

The first luncheon, held Oct. 13, 1959, was attended by 140. At this luncheon, two authorities on engines and turbines discussed current and future developments in natural-gas prime movers. Richard F. Moser, vice-president and general manager of the Reciprocating Engine Division of Clark Bros. Co., Olean, N. Y., discussed what's ahead for the petroleum industry in reciprocating engines. Roy M. Greene, general manager of the Turbo Products Division of Clark Bros. Co., also of Olean, N. Y., discussed present and future trends in turbine type of prime movers for the petroleum industry.

At the second luncheon, held Dec. 1, 1959, three of the nation's oil-well drilling and production experts went into the problems to expect in drilling and producing a 50,000-ft well. Jack Abernathy, president of Big Chief Drilling Co., Oklahoma City, Okla.; and R. L. Guernsey, field engineer for Jones and Laughlin Steel Corp., Pittsburgh, Pa., presented detailed estimates of the drilling and completion problems of such a well. Harold Kelley, chief engineer of the Production Department of Phillips Petroleum Corp., Bartlesville, Okla., went into the problems expected in producing oil from such a deep well. Attendance at this luncheon was 250.

The third luncheon was held Jan. 19, 1960. At this luncheon, attended by 140, Frank S. G. Williams, Taylor Forge Co., Chicago, Ill., a fellow of ASME and vice-chairman of the ASME Main Committee on Boiler and Pressure Vessel Codes as well as chairman of its Executive Committee, explained recent changes in the ASME Piping and Pressure Vessel Codes to Tulsa's engineers and executives.

At the fourth and final luncheon for the 1959–1960 season, one of the nation's foremost designers of centrifugal pumps, W. W. Weltmer, Allis-Chalmers Manufacturing Company, Milwaukee, Wis., explained the latest thinking on centrifugal pump design.

The foundation for the series of luncheons was laid in 1957 by W. R. Clarke, Jones & Laughlin Supply Division, Tulsa, then chairman of the Mid-Continent Section of ASME. Under Clarke's direction a Study Committee was formed and a survey made among Tulsa's engineers for such an activity by ASME.

Because of the encouraging results of the survey, the next year, the Mid-Continent Section, under the chairmanship of Elmer Beason, Phillips Petroleum Co., Bartlesville, Okla., appointed Harry W. Evans, Sinclair Oil & Gas Company, Tulsa, as director of a committee to be called the Petroleum Activities Committee.

Succeeding Beason as Section Chairman, Ed Lyle, Unit Rig & Equipment Company, Tulsa, continued to push for such an activity by the Section. Evans, a long and ardent worker in ASME's Petroleum Division, then set about to organize such a committee and to get the series of luncheons under way. Under his direction, he obtained ten ASME members in the Tulsa area to form the committee. The committee was organized along the lines of the ASME Petroleum Division with four operating committee chairmen and an appropriate number of staff-committee chairmen.

Heading up the operating committees and responsible for one of the forum luncheons were W. R. Clarke, Jones & Laughlin Supply Company, drilling and

production; B. E. Forney, National Tank Company, materials and manufacturing; G. O. Bates, Pan American Petroleum Corp., refining gas and gas processing; and R. P. Lennart, Service Pipe Line Company, pipelines.

John W. Towner, D-X Sunray Oil Co., was named secretary-treasurer. Heading up the staff committees were Alva C. Smith, Mid-Continent Pipeline Co., meetings arrangement; Paul G. Exline, Exline Engineering Company, membership; and Earl Seaton, *Oil & Gas Equipment*, news. Robert L. Smith, Sinclair Oil & Gas Company, served as vice-chairman of the News Committee.

The work of the Mid-Continent Section of ASME in undertaking such a project has been widely acclaimed by individual engineers of the Tulsa area and by other engineering societies in the area. Because of the outstanding reception received, the Mid-Continent Section plans to continue to sponsor the Petroleum Activities Committee and its work in bringing to members of the ASME Mid-Continent Section and other interested engineers, the nation's experts in the various phases of the world-wide petroleum industry.

LITERATURE

ASME Publications

"Rotating Air Cylinders and Adapters," revised American Standard B5.5–1959, has been approved by the American Standards Association and published by ASME. It is sponsored also by the Metal Cutting Tool Institute, SAE, National Machine Tool Builders Association, and ASTE. Copies cost $1 and may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Proceedings

● **"Seventh Hydraulics Conference of the Iowa Institute of Hydraulic Research."** 1959 proceedings of the conference are now available at $3.50. The 306-page volume is obtainable from the Department of Publication, State University of Iowa, Iowa City, Iowa.

● **"Second Annual Conference of the National Federation of Science Abstracting and Indexing Service."** Copies cost $3.50 and are obtainable from the federation at 301 East Capitol Street, Washington 3, D. C.

● **"Peaceful Uses of Atomic Energy,"** proceedings of the second international conference in Geneva, 1958, are now available. Further information on the contents of the 32-volume set, and order blanks may be obtained from the United Nations, Sales and Circulation (Atomic Energy), New York, N. Y.

● **"Metallurgical Society Conferences,"** a new series of volumes will present proceedings of technical conferences and committees of The Metallurgical Society of AIME. The first volume, now available, is on "Flat Rolled Products: Rolling and Treatment." The 148-page volume costs $3.75. Send orders to Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y.

Current Research

"The 1959 Review of Current Research," is edited by Renato Contini, Mem. ASME, and P. T. Bryant, editor of the *Journal of Engineering Education*. Published by the Engineering College Research Council of ASEE, the 1959 survey of engineering college research gives complete titles for all projects underway in schools which hold ECRC membership. In addition, numbers of research personnel at each institution are listed and research policies are summarized. Copies cost $2 and are available from the Secretary, ASEE, University of Illinois, Urbana, Ill.

IEC Publications

Three new publications of the International Electrotechnical Commission (IEC) are now available.

● IEC Publication 106. Recommended Methods of Measurement of Radiation From Receivers for Amplitude-Modulation, Frequency-Modulation, and Television Broadcast Transmission. Price: $3.60.

● IEC Publication 108. Recommendations for Ceramic Dielectric Capacitors Type I. Price: $3.20.

● IEC Publication 109. Recommendation for Fixed Non-Wirewound Resistors Type II. Price: $3.20.

● Copies available from: American Standards Association, Dept. PR 95, 70 East 45th Street, New York 17, N. Y.

Reactor Manual

"A Uniform Procedure for Use in Evaluation of Nuclear Power Reactors" has recently been published by the Atomic Industrial Forum. The 44-page manual will be especially useful to reactor and reactor component manufacturers, electrical utilities, architect-engineers, constructors, research and development organizations, and consultants. Copies are $1.50 and may be obtained from the Atomic Industrial Forum, 3 East 54th Street, New York 22, N. Y.

Welding

● "Welding Nuclear Power Piping" is the first national publication of welding ferrous materials for nuclear power piping operations. The 20-page report, published by AWS, represents the combined efforts of many nuclear-power specialists.

● "Titanium Welding" gives the best methods for welding titanium piping and tubing by the gas tungsten-arc process. The 24-page report is published by AWS. A most complete description is included, from an explanation of the welding process to the selection of electrode and filler metal.

● Each report costs $1.50 and may be obtained from AWS, Dept. T., 33 West 39th Street, New York 18, N. Y.

Defense Marketing Handbook

"Aerospace Marketing Handbook" is designed to help large and small businessmen to keep up with current information on missile and space programs. The handbook is a true marketing aid aimed specifically at helping sales departments to market goods and services to the major missile and space programs. A four-page color brochure describes the handbook in detail and is available upon request to: Defense Marketing Services, Inc., 600 North Sepulveda Boulevard, Los Angeles 49, Calif.

Pirated Editions

"Pump Questions and Answers," by Igor Karassik, Mem. ASME, and five engineers of the Worthington Corporation, Harrison, N. J., had been published originally in 1949 by the McGraw-Hill Book Company, Inc. Recently, a version of the book, a photo copy of the original, turned up in Red China. Only two changes had been made. The McGraw-Hill name was replaced by the seal of the Chinese publisher and a list of new books from that publisher was included.

New Publications

Vectors is a new quarterly publication

of the Hughes Aircraft Company. The first issue appeared during the fourth quarter of 1959. *Vectors* will report on developments in higher electronics and on significant progress in other scientific fields. There will be subjects of specific technical interest as well as those "popular" in nature. For further information, address: Editor, *Vectors*, Hughes Aircraft Company, Culver City, Calif.

Guidance Booklet

"ENGINEERING," by E. H. Robie, former secretary, AIME, is number 14 in a series of Vocational and Professional Monographs published by the Bellman Publishing Company, Cambridge, Mass. The booklet is a valuable aid in the area of general counseling and for individual reference purposes in choosing a career. A brief history of engineering, qualifications for employment, training required, earnings, and other sources of professional information are given in the 36-page booklet. Copies are $1 and may be obtained from Bellman Publishing Company, P. O. Box 172, Cambridge 38, Mass.

Conventions Calendar

"ENGINEERING and Technical Conventions," the 1960 edition, is now available from Industrial Relations News, 230 West 41st Street, New York 36, N. Y., at $4 per copy. Prepared annually by Deutsch & Shea, Inc., technical manpower consultants, the booklet lists the national, regional, and state meetings and conventions of more than 100 engineering and scientific organizations. The list is comprehensive for the forthcoming year. In addition, advance information is included through 1964.

Literature-Search Service

A NEW, electronic metallurgical searching service with a 100,000 titles-per-hour capacity will be launched early in 1960 by the American Society for Metals, whose headquarters are at Novelty, Ohio, east of Cleveland.

The new facility, to be known as the ASM Metals Documentation Service, will save thousands of dollars for those needing specific information on metallurgical problems. It is an outgrowth of four years of research and pilot plant experience in the field of indexing and machine searching.

This research has been carried on by the Center for Documentation and Communication Research, School of Library Science, Western Reserve University, Cleveland, Ohio.

New Gas Turbine Magazine

Gas Turbine Magazine and its companion the "Gas Turbine Catalogue," is a bimonthly magazine published by Diesel Publications, Inc. The magazine and catalog will be under the editorial direction of R. Tom Sawyer, Fellow ASME, an international authority on gas turbine engines. Six editors, each a specialist in one segment of this broad industry, will be responsible for departments such as aero-space, marine, stationary, accessory, processing, and automotive.

With an initial circulation guarantee of 5000, the first issue of the publication was published and distributed during January, 1960.

Gas Turbine Magazine is designed to report, interpret, predict, and promote the activities and interest of the gas-turbine industry in all areas of gas-turbine application.

Gas Lubricated Bearings

"A BIBLIOGRAPHY on Gas-Lubricated Bearings—Revised," by E. B. Sciulli, is a revision and expansion of bibliography issued in 1957 as The Franklin Institute Laboratories Interim Report I-A2049-1. The compilation contains 290 references with abstracts and five indexes.

Copies cost $2.50 each and may be obtained from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Science Encyclopedia Scheduled for Fall Publication

THE McGraw-Hill Book Company recently announced that it has finished and sent to the printer the manuscript of the largest technical publication ever undertaken in the English language—an Encyclopedia of Science and Technology which has been in preparation for over four years.

The work will be published in 15 large volumes next fall. The first printing will be at least 25,000 sets, but this may be increased to as many as 50,000 sets, according to McGraw-Hill's president, Curtis G. Benjamin.

"Never in our long history of technical book production has any other publication created so much prepublication interest and so many long lines of waiting customers," Mr. Benjamin said. "And never before has a technical publication ranked so high as a mass production job in the book industry. A minimum printing of 25,000 sets will be the equivalent of 1,125,000 copies of the ordinary trade book. For the first time technical publishing has broken far beyond its traditional bounds of specialized markets."

The McGraw-Hill Encyclopedia of Science and Technology will contain 7224 articles written by some 2000 authorities on their respective subjects. The work of these contributors was guided by a large corps of consulting editors, each a specialist in one of 62 assigned fields of mathematics, engineering, physical science, life science, earth science, agriculture, conservation, meteorology, space technology, and so on. All this work was co-ordinated, and the manuscripts were edited and illustrated, under the direction of William Crouse, Editor-in-Chief.

The work as a whole was developed under the general direction of an Editorial Advisory Board of distinguished scientists and engineers, including Roger Adams, professor-emeritus of Chemistry and formerly head of the Department of Chemistry and Chemical Engineering of the University of Illinois; Joseph W. Barker, past-president, ASME, and retired president of Research Corporation; Detlev Bronk, Hon. Mem. ASME, president of The Rockefeller Institute, and president of the National Academy of Sciences; George R. Harrison, dean of the School of Science, Massachusetts Institute of Technology; Sidney D. Kirkpatrick, Mem. ASME, former Editorial Director of Chemical Publications, McGraw-Hill Publishing Company; William Rubey, research geologist of the U. S. Geological Survey; and Edmund Sinnott, Professor-Emeritus, Yale University.

Conducted for the National Junior Committee

J.R. BERENDES

JUNIOR FORUM

Patents Reconsidered

By Anthony S. Zummer[2]

As a group, engineers fail to recognize their responsibility to their respective employers of protecting the products of their work. Consequently, there are many instances wherein an employer loses the right to exclusive use of the work performed by its engineers and those engineers fail to receive proper recognition. An excellent method of preserving exclusive use of certain engineering works is by patents. In order that patent applications be filed on important work, engineers have a duty to apprise management of all of their work which, in their opinion, may be copied by a competitor.

The efforts of engineers result in designs and developments which are either (1) products of creative and imaginative thinking, or (2) merely the end results of the application of well-known formulas and principles plus an assemblage of standard components.

In the second case, engineers use only formulas and principles learned by experience or from training in school or from other engineers. In the first case, however, engineers actually make an invention, but only too often the engineer attributes his invention to his excellent training rather than to creative thinking.

Such excessive humility about his creative ability becomes a detriment to the engineer's employer because the products of engineer's creativeness are then not protected in any manner; a competitor may, with impunity, copy the results of months or years of engineering efforts. The engineer himself also suffers a loss because whatever recognition he receives within his own organization for his efforts is often erased by the passage of years. Perhaps the greatest loss to the engineer is his failure to fulfill all of his duties as a professional employee to his employer; usually, he does not even realize that he has failed in this duty.

Training of young men, both in engineering colleges and in company training programs, develops engineers who are zealous in making accurate calculations, assimilating facts, and producing precise results. Unfortunately, the training that a young engineer receives often fails to instill in him the realization that, as a member of the engineering profession, he has a personal responsibility to protect the products of his efforts for the benefit of his employer by presenting to management his new development and pointing out why his development should be patented.

Engineers Should Initiate Patent Applications. It is obvious that patents may be extremely valuable to an employer corporation by protecting the developments of the corporation. The primary obligation to see that the corporation has protection on each new development made within that corporation rests with the engineer who makes the development because he knows best the advantages of his work product over that existing in the art.

A manufacturing corporation patent owner may receive benefits from a patent in two ways: First, the corporation may keep a competitor from making an identical or similar product which may be particularly successful in its field. A superior product which is easily marketable is of considerable importance to a corporation; and when it is possible to keep competitors from making this same product or one that is competitive, profits can be increased. Second, the corporation may collect royalties on the patent. Should a particular improvement be highly desirable throughout the industry, and the patent owner be unable to exploit the patent by making and selling the product itself, it may license other organizations to manufacture the product under the patent and thus receive a royalty. In some cases, royalties may be greater than profits that could be obtained by additional capitalization and expansion of existing facilities.

Engineers Receive Indirect Benefits From Patents. Many engineers recognize the benefits that accrue to his employer from patents, but they fail to realize that they, as individuals, also may receive an indirect benefit, even though the patent itself may have been assigned to the employer.

The engineer who makes an invention receives a personal benefit when a patent is obtained on his invention because his name appears as patentee, although the benefit may not be obvious immediately. An engineer who has a patented invention has the advantage of having a permanent record of this particular contribution to his employer. His contribution may be used as a basis for promotion by management, for they have before them the record of the fruits of the engineer's endeavors.

Since management sometimes takes production processes for granted, and those processes are usually known only within the organization, engineers have difficulty receiving recognition for their achievements in developing new processes or improving old ones. But, by means of a patent, an engineer in manufacturing can make his contributions known within his organization.

Benefits which the engineer patentee receives from a patent are not restricted to recognition within his own organization. The engineer receives recognition from fellow engineers because he has made a contribution to the general fund of scientific knowledge. Thus he develops prestige among other engineers as well as prestige within his community for himself and the entire engineering profession.

In the course of events, the engineer sometimes finds that he must leave his present organization. Should he be compelled to go to work for another organization, one of the best recommendations that the engineer could possibly have is that he is a patentee of a

Chairman's Corner

The purpose of "Junior Forum" is the publishing of articles which describe career areas for the young engineers. If you would care to author or to see an article pertaining to any particular field, please let us know and we will be glad to review and in most cases publish your articles. Any such article should be sent to: Mr. J. R. Berendes, Combustion Engineering, Inc., 105 West Adams Street, Chicago 3, Ill.

[1] Sales Representative, Combustion Engineering, Inc., Chicago, Ill. Assoc. Mem. ASME.

[2] Patent Lawyer, Chicago, Ill. Assoc. Mem. ASME.

particular patent which that organization has been trying to avoid, or for which it is paying royalties to manufacture under the patent. Thus his future employer would certainly be aware of the engineer's ability.

Even if his prospective employer knew nothing of the engineer's patent, it would be a simple task for the employer to look at the engineer's actual achievements as shown in patents that had been granted to the engineer. There could be no question of what the engineer contributed, for it is plainly displayed in the public records of the United States Government.

What Should Be Patented? Engineers who make an invention often neglect to obtain a patent on their invention because they forget that patents may be granted for improvements in articles, machines, or processes, as well as for a completely new article, machine, or process. Management also may fail to appreciate a new development because it is not presented to them as a patentable improvement over what is known in the field. As a result, a patent is not obtained on a development which may become one of the company's most important items of manufacture or a very efficient process.

The engineer who makes an improvement indeed has a difficult problem when he tries to decide whether he has made an actual invention. When it is considered that patent attorneys sometimes argue for days, weeks, and even months, on the question of what constitutes an invention, there is a sound reason for the engineer not knowing whether he has or has not made an invention in the legal sense. The simplest tests for an engineer to use in determining whether a patent application should be filed on his work are these:

1 Is the particular improvement different than anything he knows about?

2 If the improvement is different, would it be worth while for a competitor to copy this improvement?

If the improvement is worth copying, a patentability search should be made and application should be filed in the event that the improvement appears patentable.

Engineers Should Record Ideas. The simplest manner in which an engineer may show what are his ideas, and when they occurred to him, is to make a record of each idea that he may have, and to record the events of each day as they pertain to his work. This record is best kept in a daily diary or logbook.

It is not necessary to write a long report on the day's activities, often a line or two will be sufficient to record the high lights of the day. Though the record may be brief, it should be complete. If an idea is worth recording, it should be recorded so that a stranger may read the entry and understand the idea. All sketches made in the record should be labeled and an accurate description should accompany the sketch explaining the operation of the device so that there will be no question at a later date as to what the sketch means.

Conclusion. In order to protect properly the product of his work for his employer, the engineer has the duty as a professional employee to promote the patenting of his improvements. The resulting patents are beneficial to the employer since they may prevent a competitor from copying a successful product or they may be the source of substantial royalties. The engineer also gets the benefit of recognition both within and without his organization.

The engineer need only apply a simple test to determine whether a patent application should be considered for his work: Decide whether someone would want to copy his original development.

To insure that the correct person is named as patentee, the engineers in an organization have the obligation to themselves, their fellow engineers, and their employer to keep diligent records of their work.

ASME CODES AND STANDARDS WORKSHOP

Interpretations of 1955 Code for Pressure Piping

From time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinions of the Committee.

Pending Revision of the Code for Pressure Piping, ASA B31.1–1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Cases N-1, N-7, N-8, N-9, and N-10 are published herewith as an interim action of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the ASA on a revision of the Code.

Case N-1 is an "enabling" Case. Cases N-7, N-8, N-9, and N-10 are specific Cases. Case N-2 and Case N-6 are not ready for publication at this time; however, they are currently under review by the Advisory Committee on Nuclear Piping and will be submitted to the Executive Committee for review and approval at the earliest possible date.

N-1 General Requirements for Nuclear Power-Plant Piping

Under what sections of the ASA Code for Pressure Piping should piping in nuclear power plants be designed and constructed? What special requirements must be met?

It is the opinion of the Committee:

1 That piping associated with nuclear power plants falls into two categories:

(*a*) Conventional steam and associated service piping, not falling under the definition of nuclear piping (see item *b*). This piping shall be designed and constructed in accordance with Section 1 B31.1–1955.

(*b*) Nuclear piping which is defined as that piping designed to contain a fluid whose loss from the system could result in a radiation hazard either to the plant personnel or to the general public. Power piping coming within the scope of this definition shall be designed and constructed in accordance with Section 1 B31.1–1955, supplemented by the rulings and case interpretations identified by the prefix "N."

2 That specific exclusions and special requirements will be covered in nuclear cases as they are developed. These will be issued and numbered with the prefix "N."

N-7 Austenitic Steels for Aqueous-Type Nuclear Reactor Systems

Inquiry: May types 304, 304L, 316, 316L, 321, 347, 348, 309, and 310 grades of stainless steel be used for piping of aqueous-type reactors in nuclear energy installations under the rules of Section 1 of the Code for Pressure Piping?

Table 1 Allowable Stress Values for Seamless Materials

	TEMPERATURE, F									
	—20 to 100	200	300	400	500	600	650	700	750	800
304	18,750	16,650	15,000	13,650	12,500	11,600	11,200	10,800	10,400	10,000
304L	17,500	15,300	13,100	11,000	9,700	9,000	8,750	8,500	8,300	8,100
316	18,750	18,750	17,900	17,500	17,200	17,100	17,050	17,000	16,900	16,750
316L	17,500	16,250	14,500	12,000	11,000	10,150	9,800	9,450	9,100	8,800
321, 347, 348	18,750	18,750	17,000	15,800	15,200	14,900	14,850	14,800	14,700	14,550
309	18,750	18,750	17,300	16,700	16,600	16,500	16,450	16,400	16,200	15,700
310	18,750	18,750	18,500	18,200	17,700	17,200	16,900	16,600	16,250	15,700

Note: These stress values do NOT include joint factors or quality factors.

Reply: It is the opinion of the Committee that types 304, 304L, 316, 316L, 321, 347, 348, 309, and 310 stainless steels may be used for piping of aqueous-type reactors in nuclear energy installations for construction under Section 1, provided the following conditions are observed:

1 The materials shall at least conform to one of the following specifications:

Pipe	A376 A358
Welding fittings Forgings	ASTM A403 ASTM A182

The minimum carbon content of Types 304, 316, 321, 347, 348, 309 and 310 shall be 0.04 to 0.10 per cent by check analysis, and the maximum carbon content of types 304L and 316L shall be 0.035 per cent by check analysis.

2 If welding is employed, all completed welds shall be inspected as follows:

(*a*) All longitudinal welds shall be fully radiographed.

(*b*) All circumferential welds shall be fully radiographed.

(*c*) Where the size or configuration of the weld does not permit effective radiographing, it shall be examined by the fluid penetrant method.

(*d*) Provisions (*a*) through (*c*) do not apply for services at or near the ordinary range of atmospheric temperatures, where these materials are employed primarily for their corrosion resistance, provided the piping is hydrostatically tested at $1^1/_2$ times the maximum allowable working pressure for the piping used.

3 The design temperature shall not exceed 800 F.

4 The allowable stress values for seamless materials are shown in Table 1.

5 A joint factor of 1.00 shall be applied to welded construction that has been fully radiographed.

N-8 Austenitic Pipe for Nuclear Energy Installations Using Sodium or Sodium-Potassium Mixtures

Inquiry: May types 304, 316, 321, 347, 348, 309, and 310 stainless steels be used for piping of nuclear energy installations handling liquid sodium and sodium-potassium mixtures under the rules of Section 1 of the Code for Pressure Piping (ASA B31.1)?

Reply: It is the opinion of the Committee that types 304, 316, 321, 347, 348, 309, and 310 stainless steels may be used for the piping of nuclear energy installations handling liquid sodium and sodium-potassium mixtures for construction under Section 1, provided the following conditions are observed:

1 The materials shall at least conform to one of the following specifications:

Pipe	ASTM A 376 ASTM A 358
Welding Fittings Forgings	ASTM A 403 ASTM A 182

The carbon content shall be 0.04 to 0.10 per cent by check analysis.

2 If welding is employed, all completed welds shall be inspected as follows:

(*a*) All longitudinal welds shall be fully radiographed.

(*b*) All circumferential welds shall be fully radiographed.

(*c*) Where the size or configuration of the weld does not permit effective radiographing, it shall be examined by the fluid penetrant method.

3 The allowable stress values for seamless materials shall be as follows:

Temp F	304	316	321, 347, 348	309	310
—20 to 100	18,750	18,750	18,750	18,750	18,750
200	16,650	18,750	18,750	18,750	18,750
300	15,000	17,900	17,000	17,300	18,500
400	13,650	17,500	15,800	16,700	18,200
500	12,500	17,200	15,200	16,600	17,700
600	11,600	17,100	14,900	16.500	17,200
650	11,200	17,050	14,850	16,450	16,900
700	10,800	17,000	14,800	16,400	16.600
750	10,400	16,900	14,700	16,200	16,250
800	10,000	16,750	14,550	15,700	15,700
850	9,700	16,500	14,300	14,900	14,900
900	9,400	16,000	14,100	13,800	13,800
950	9,100	15,100	13,850	12,500	12,500
1000	8,800	14,000	13,500	10,500	11,000
1050	8,500	12,200	13,100	8,500	7,100

Note: These stress values do NOT include joint factors or quality factors.

4 It shall be the responsibility of the designer to take into account the decarburization of stainless steels in sodium and NaK.

5 A joint factor of 1.00 shall be applied to longitudinal welds which have been fully radiographed.

N-9 Centrifugally Cast Austenitic Steel Pipe for Nuclear Service

Inquiry: Under what conditions may centrifugally cast austenitic stainless steel pipe be used within the scope of Section 1 of the Code for Pressure Piping for nuclear service?

Reply: It is the opinion of the Committee that the intent of the Code will be satisfied provided the following conditions are met:

1 Chemistry and Mechanical Property Requirements:

(*a*) The chemistry and tensile requirements shall be as given in ASTM A351. These shall be established from a sample ring cut from one end of each length of pipe, using the testing procedure given in ASTM Specification A-370

(*b*) The bending properties shall be established as required by ASTM A-376, paragraphs 10 and 11.

2 Finish: The inside and outside surfaces shall be finish machined.

The material shall have a finish of 250 micro-in. RMS or 225 micro-in. AA or better.

3 Testing:

(*a*) *Pressure Test:* Each length of pipe shall be given a pressure test and shall show no leaks with the test pressure held for a period of 30 min per in. of wall thickness. The test pressure shall be at least 1.5 times the rated pressure of the pipe at room temperature, except that the stress developed at the test pressure shall not exceed 90 per cent of the specified minimum yield strength based on the actual wall thickness.

(*b*) *Surface Inspection—Fluid Penetrant:* In addition to visual inspection, all surfaces of each length shall be inspected by the fluid penetrant method. The following standards of acceptance shall be met:

All linear discontinuities and aligned penetrant indications revealed by the test shall be removed. Aligned penetrant indications are those in which the average of the center-to-center distances between any one indication and the two adjacent indications in any straight line is less than $^3/_{16}$ of an in.

All other discontinuities revealed on the surface need not be removed unless the discontinuities are also revealed by radiography, in which case the pertinent radiographic specification shall apply.

(*c*) *Radiography:* Each length of pipe shall be completely radiographed in accordance with ASTM E-94 and shall meet the requirements of ASTM E-71 for Class 2 quality castings.

4 Repair of Defects:

Defects disclosed by inspection and testing may be repaired by welding under the following conditions:

(*a*) The defect shall be removed and the surface of the cavity rendered clean.

(*b*) Repair welding shall be done using procedures and operators that have been qualified in accordance with the requirements of ASTM A-376.

(*c*) All repair welds shall be examined by the same procedures and to the same standards as the original cast material.

(*d*) If the material had been heat-treated before making the repair weld, the length shall be reheat-treated.

5 Heat-Treatment:

Heat-treatment shall consist of 1950 F minimum metal temperature and shall be cooled in air or liquid medium at a rapid rate.

6 Requirements after Hot-Forming Operations:

Pipe sections that have been subjected to hot-forming operations such as bending, swaging, forging, van-stoning, and similar forming operations shall be reheat-treated in accordance with paragraph five, and fluid penetrant tested.

7 Records:

(*a*) *Test Reports:* Certified test reports shall give the results of the chemical and tensile properties, and shall specifically indicate that each of the other test requirements in this Case have been met. In the event that the inspector did not witness the removal and repair welding of any defects, the test report shall contain a statement as to the number, approximate extent, and location of such repairs.

(*b*) All radiographs of original material and repaired areas shall be kept for a period of three years and shall be available to the inspector at all times.

8 Retests:

If the results of any chemical or mechanical tests do not conform to the requirements, retests shall be made on additional ring samples of double the original number, each of which shall conform to the requirements as specified.

9 Special Requirements:

It shall be the responsibility of the designer to require any or all of the following where service conditions or welding requirements warrant and when so specified become a requirement of this Case.

(*a*) Where gaseous products of nuclear fission are anticipated, mass spectrometer or other gaseous leakage tests shall be specified.

(*b*) Where cold-forming or hot-forming are to be considered, ductility shall be compatible with the type of forming.

10 Allowable Stress Values:

The maximum allowable stress for use under this Case shall be as given in the table.

Maximum Allowable Stress Values in Tension, Psi

ASTM A351 grade	CF8	CF8M	CF8C	CH20	CK20
Spec min tensile	70000	70000	70000	70000	65000
Temperature					
−20 to +100	17500	17500	17500	17500	16250
200	15700	16900	17000	16100	15300
300	14250	16500	15600	15150	14900
400	13100	16300	14200	14600	14600
500	12200	15900	13000	14550	14550
600	11700	15350	12200	14450	14450
650	11500	15000	11900	14400	14400
700	11300	14700	11700	14350	14350
750	11100	14350	11600	14300	14300
800	10900	14000	11500	14150	14150
850	10650	13500	11350	13900	13900
900	10400	13000	11200	13500	13500
950	10100	12350	11100	12500	12500
1000	9850	11700	11000	10500	11000
1050	9600	10600	10900	8500	9750

Note: These stress values are based on a casting quality factor of 1.00.

N-10 Cast Austenitic Butt Welding Fittings for Nuclear Service

Inquiry: Under what conditions may cast austenitic steel butt welding fittings be used within the scope of Section 1 of the Code for Pressure Piping for nuclear service?

Reply: It is the opinion of the Committee that ASTM Specification A-351 and ASA B16.9 are not sufficiently definitive for acceptance for Nuclear service as currently written. It is the opinion of the Committee that the intent of the Code will be satisfied provided the following conditions are met:

1 Chemistry and Mechanical Property Requirements:

(*a*) The chemistry and tensile requirements shall be as given in ASTM A-351 and shall be established using testing procedures as given in ASTM A-370. The test bars attached to the keel blocks shall be of such dimensions that they shall reflect the greatest casting thickness and there shall be a minimum of three test bars per heat per heat-treatment lot and they shall be marked with the heat numbers and other pertinent identification. The test bars shall accompany the castings through all heat-treatment.

2 Finish:

(*a*) The castings shall meet the requirements of A-351, Paragraph 18. Particular attention is directed to the prohibition against plugging in Paragraph 18 (*b*).

(*b*) Fittings shall have an interior surface finish of 250 micro-in. RMS or 225 micro-in. AA or finer.

3 Testing:

(*a*) *Pressure Test:* Each fitting shall be given a pressure test and shall show no leaks with the test pressure held for a period of 30 min per in. of wall thickness. The test pressure shall be at least 1.5 times the rated pressure of the fitting at room temperature, except that the stress developed at the test pressure shall not exceed 90 per cent of the specified minimum yield strength based on the minimum specified wall thickness.

(*b*) *Surface Inspection—Fluid Penetrant:* In addition to visual inspection, all surfaces of each fitting shall be inspected by the fluid penetrant method. The following standards of acceptance shall be met:

All linear discontinuities and aligned penetrant indications revealed by the test shall be removed. Aligned penetrant indications are those in which the average of the center-to-center distances between any one indication and the two adjacent indications in any straight line is less than $^3/_{16}$ in.

All other discontinuities revealed on the surface need not be removed unless the discontinuities are also revealed by radiography, in which case the pertinent radiographic specification shall apply.

(*c*) *Radiography:* Each fitting shall be completely radiographed in accordance with ASTM E-94 and shall meet the requirements of ASTM E-71 for class 2 quality castings.

4 Repair of Defects:

Defects disclosed by inspection and testing may be repaired by welding under the following conditions:

(*a*) The defect shall be removed and the surface of the cavity rendered clean.

(*b*) All basic requirements and optional requirements for repairs of defects and retest shall be in accordance with the applicable paragraphs of ASTM A-351 and shall be mandatory except that reheat-treatment following repairs shall be commensurate with the service.

(*c*) All repair welds shall be examined by the same procedures and to the same standards at the original cast material.

5 Heat-Treatment:

Each treatment shall consist of 1950 F minimum metal temperature and shall be cooled in air or liquid medium at a rapid rate.

6 Records:

(*a*) *Test Reports:* Certified test reports shall give the results of the chemical and tensile properties, and shall specifically indicate that each of the other test requirements in this case have been met. In the event that the inspector did not witness the removal and repair welding of any defects, the test report shall contain a statement as to the number, approximate extent, and location of such repairs.

(*b*) All radiographs of original material and repaired areas shall be kept for a period of three years and shall be available to the inspector at all times.

7 Retests:

If the results of any chemical or mechanical tests do not conform to the requirements, retests must be made in accordance with Paragraph 11 of ASTM A-351.

8 Special Requirements:

It shall be the responsibility of the designer to require any or all of the following where service conditions or welding requirements warrant and when so specified become a requirement of this Case.

(*a*) Where gaseous products of nuclear fission are anticipated, mass spectrometer or other gaseous leakage tests shall be specified.

(*b*) Commensurate with the service,

1 The chemistry and tensile requirements shall be as given in ASTM A-351. The tensile requirements shall be determined from a sample ring cut from one end of each fitting using the testing procedures as given in ASTM A-370;

2 The flattening properties shall be established as required by ASTM A-376, Paragraph 11.

9 Allowable Stress Values:

Fittings produced in compliance with this Case shall be based on allowable stress data as given in the table.

Maximum Allowable Stress Values in Tension, psi

ASTM A351 grade	CF8	CF8M	CF8C	CH20	CK20
Spec. min. tensile	70000	70000	70000	70000	65000
Temperature					
−20 to +100	17500	17500	17500	17500	16250
200	15700	16900	17000	16100	15300
300	14250	16500	15600	15150	14900
400	13100	16300	14200	14600	14600
500	12200	15900	13000	14550	14550
600	11700	15350	12200	14450	14450
650	11500	15000	11900	14400	14400
700	11300	14700	11700	14350	14350
750	11100	14350	11600	14300	14300
800	10900	14000	11500	14150	14150
850	10650	13500	11350	13900	13900
900	10400	13000	11200	13500	13500
950	10100	12350	11100	12500	12500
1000	9850	11700	11000	10500	11000
1050	9600	10600	10900	8500	9750

Note: These stress values are based on a casting quality factor of 1.00.

How Well Do You Know Your Society?

So that the members of ASME may know their Society, attention is called to the list of Manuals and Annuals available upon request from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Unless otherwise noted, all the items in the list will be sent without charge.

AC 2 Annual Report of ASME Research

AC 10 Personnel of Council, Boards, and Committees

AM 1 Membership List—Alphabetical and Geographical (Biennial—odd-numbered years)

AM 3 Catalog of Publications (also included in "Mechanical Catalog")

AM 4 Members List—Listed by Companies (Biennial—even-numbered years, $2 each)

AM 5 Indexes to ASME Papers and Publications

MM 1 Certificate of Incorporation, Constitution, By-Laws, and Rules

MM 2 Know Your Society

MS 4 An ASME Paper (50 cents to nonmembers)

MS 61 Citizenship and Participation in Public Affairs

ACTIONS ASME EXECUTIVE COMMITTEE

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Friday, Feb. 5, 1960. There were present: W. L. Cisler, President; T. J. Dolan, W. H. Larkin, H. N. Muller, and R. B. Smith of the Executive Committee; V. W. Smith, a Director; E. J. Kates, Treasurer; H. J. Bauer, Assistant Treasurer; D. W. R. Morgan, Past-President; D. E. Marlowe, Vice-President; F. L. Schwartz, Organization Committee Chairman; E. J. Schwanhausser, Finance Committee Chairman; Joseph Pope, ASME Representative to EJC; J. A. Tillinghast, Secretary to the Research Committee on Properties of Steam; O. B. Schier, II, Secretary; T. A. Marshall, Jr., Senior Assistant Secretary; W. E. Letroadec, W. E. Reaser, S. A. Tucker, and J. D. Wilding, Assistant Secretaries; J. J. Jaklitsch, Jr., Editor; H. I. Nagorsky, Controller; D. B. MacDougall, associate Head, Field Service; and J. T. Reid, Research Manager.

The following actions are of general interest:

Society Government—Office of the President. Upon recommendation of the Organization Committee, the Executive Committee of the Council voted to request the Constitution and By-Laws Committee to make the necessary changes to provide for the Vice-President having the longest consecutive service as Vice-President to be President pro tem so that he may call an executive session of the Council, within one month after the vacancy in the Presidency occurs, to permit the Council to elect a new President from one of its own elected members. Should two or more Vice-Presidents have equal length of consecutive service as Vice-President, the one being senior by length of corporate membership in the Society shall be President pro tem.

Council Policy on Custodian Funds. The Council voted to approve the revision of Council Policy on Custodian Funds, P-4.1, to permit the establishing of Custodian Funds for the Sections when requested. Also voted to authorized the establishment of custodian funds to be administered by the Society for the Hartford Section and for the San Francisco Section so that each Section may solicit funds for Scholarship purposes.

Board on Codes and Standards. ASME International Standardization Committee. The Council voted to authorize the formation of the ASME International Standardization Committee for the purpose of receiving, considering, and making recommendations to the Board on policy matters referred to the Society concerning participation in International Standardization under IEC, ISO, or other scopes. In performance of this function the Committee may ask for related information concerning national participation in standardization from the Standardization, Power Test Codes, and Pressure Vessel Committees.

Further, to request the Constitution and By-Laws Committee to prepare the necessary By-Law change for first reading at the Semi-Annual Meeting in Dallas, Texas.

Boiler and Pressure Vessel Committee. Welding Research Council. The Council voted to authorize the payment of $1000 to the Welding Research Council of the Engineering Foundation as the 1960 contribution of the Society to the work of the Pressure Vessel Research Committee.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME | FIRST NAME | MIDDLE NAME

POSITION TITLE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NATURE OF WORK DONE

NAME OF EMPLOYER (Give name in full)

Division, if any

*☐

EMPLOYER'S ADDRESS | City | Zone | State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS | City | Zone | State

☐

PRIOR HOME ADDRESS | City | Zone | State

* CHECK "FOR MAIL" ADDRESS

Address changes effective when received prior to:

I subscribe to

- ☐ MECHANICAL ENGINEERING — 10th of preceding month
- ☐ *Journal of Engineering for Power*
- ☐ *Journal of Engineering for Industry*
- ☐ *Journal of Heat Transfer*
- ☐ *Journal of Basic Engineering*
- ☐ *Journal of Applied Mechanics* — 20th of preceding month
- ☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

- ☐ A—Aviation
- ☐ B—Applied Mechanics
- ☐ C—Management
- ☐ D—Materials Handling
- ☐ E—Oil and Gas Power
- ☐ F—Fuels
- ☐ G—Safety
- ☐ H—Hydraulics
- ☐ I—Human Factors Group
- ☐ J—Metals Engineering
- ☐ K—Heat Transfer
- ☐ L—Process Industries
- ☐ M—Production Engineering
- ☐ N—Machine Design
- ☐ O—Lubrication
- ☐ P—Petroleum
- ☐ Q—Nuclear Engineering
- ☐ R—Railroad
- ☐ S—Power
- ☐ T—Textile
- ☐ U—Maintenance and Plant Engineering
- ☐ V—Gas Turbine Power
- ☐ W—Wood Industries
- ☐ Y—Rubber and Plastics
- ☐ Z—Instruments and Regulators

Air-Pollution Controls Committee Reorganization. Upon recommendation of the Organization Committee, the Council voted to approve the reorganization of the Air-Pollution Controls Committee to provide an Executive Committee, a Main (or General) Committee, and an Advisory Committee.

Student Section. The Society has been notified of the change of name of Alabama Polytechnic Institute to Auburn University. The ASME Student Section on the campus has been renamed accordingly.

Development and Application Time Lag Funds. The Council voted to authorize the appropriation of $500 to cover the cost of printing and mailing of letters to selected research organizations and to executives in leading companies here and abroad for the purpose of obtaining information on the possibility of reducing the time lag between scientific developments and their practical application.

Certificates of Award. A special certificate for seventy years of membership in the Society was authorized for the following: Charles H. Davis, Frank G. Hobart, and Edward A. Muller.

The preparation of certificates of award for outstanding and unusual service was authorized for the following retired Faculty Advisers, each having served from 1956 to 1959: Robert E. Crank, Kansas State University; Frank R. Campbell, Colorado School of Mines; R. E. Jenkins, Southwestern Louisiana Institute; and Eric J. Lindahl, University of Wyoming.

A Certificate of award has been prepared for D. W. VerPlanck, retiring chairman of the Board on Education. Also for John F. Barkley, retired chairman and member of the Research Committee on Corrosion and Deposits from Combustion Gases.

Retired Section Chairmen for whom certificates of award have been prepared include the following 1958–1959 Section Chairmen: Charles P. Welch, C-A-M; M. D. Gunselman, Erie; Ambrose Kennedy, Mid-Hudson; Paul T. Paraskevas, Mid-Jersey; Gordon F. Leitner, Milwaukee; R. H. Podoloff, New Haven; Thomas F. Furlong, Northwest Florida; Sam F. Montroy, Sabine; A. A. Rasmussen, South Texas; and John M. Lile, Jr., Central Arkansas Subsection.

Appointments. Virgil Rowland was appointed to represent the Society at the XII International Congress of Scientific Management, Feb. 22–March 4, 1960, Sydney and Melbourne, Australia.

C. H. Shumaker was appointed to represent the Society at the Inauguration of President, Feb. 27, 1960, at Arlington State College, Arlington, Texas.

ASME COMING EVENTS

April 4-8

Nuclear Congress and Exhibit, Coliseum, New York, N. Y.

April 7-8

ASME-SAM Management Conference, Statler Hilton Hotel, New York, N. Y.

April 20-21

ASME-AIEE Railroad Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 24-29

ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting (joint with the National Board of Boiler and Pressure Vessel Inspectors), Brown Palace Hotel, Denver, Colo.

April 25-26

ASME Maintenance and Plant Engineering Conference, Chase-Park Plaza Hotels, St. Louis, Mo.

April 25-29

ASME Metals Engineering Division-AWS Conference, Hotel Biltmore, Los Angeles, Calif.

May 17-19

ASME Production Engineering Conference, Hotel Schroeder, Milwaukee, Wis.

May 22-26

ASME Oil and Gas Power Conference and Exhibit, Muehlebach Hotel, Kansas City, Mo.

May 23-26

ASME Design Engineering Conference and Show, The Coliseum, New York, N. Y.

June 5-9

ASME Semi-Annual Meeting and Aviation Conference, Statler Hilton Hotel, Dallas, Texas

June 20-22

ASME Applied Mechanics Conference, The Pennsylvania State University, University Park, Pa.

June 27-29

ASME West Coast Applied Mechanics Conference, The California Institute of Technology, Pasadena, Calif.

August 15-17

ASME-AIChE Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N. Y.

September 7-9

ASME Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass.

September 15-16

ASME-AIEE Engineering Management Conference, Morrison Hotel, Chicago, Ill.

September 18-21

ASME Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

September 21-23

ASME-AIEE Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

October 9-12

ASME Rubber and Plastics Conference, Lawrence Hotel, Erie, Pa.

October 17-19

ASME-ASLE Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

October 24-25

ASME-AIME Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

November 27-December 2

ASME Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(For Meetings of Other Societies see page 126)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers 50 cents; to ASME Members, free.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after April 25, 1960, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and Transfers

Alabama

WARLICK, JOHN H., JR., Birmingham
● WASHINGTON, WILLIAM H., JR., Decatur

Arkansas

CARTER, JACK T., Little Rock
CHILES, ROBERT L., JR., Osceola

California

BAIN, ANDREW, San Francisco
CARROLL, CHARLES E., Pittsburg
HABIB, JAMAL N., Los Angeles
HERR, PAUL N., Sacramento
HUNT, JAMES R., Los Angeles
JOHN, STANLEY R., Pomona
KARLIK, LUBOR J., Hollywood
● MCCAULEY, BRUCE G., Orinda
● PISTER, KARL S., Berkeley
SULLWOLD, JOHN L., Los Angeles
TOKERUD, LLOYD D., Irvington
WILKHOLM, DUANE E., Culver City
WRIGHT, LEE E., Alhambra

● Transfer to Member or Affiliate

Connecticut

● BUCHALTER, LLOYD A., Ridgefield
● MERZ, KENNETH A., Cornwall Bridge

Delaware

PIERCE, RICHARD M., Wilmington

Florida

● CRIM, DONALD R., Gulf Breeze

Georgia

● BOGGS, EUGENE W., Port Wentworth
CAIRNS, FRANK G., JR., Atlanta

Hawaii

BOVA, JOSEPH P., Honolulu
HILLINGA, HENRY S., Honolulu
ONZUKA, ROBERT F., Oahu

Idaho

● GRIFFITHS, JESSE J., Idaho Falls

Illinois

GRAY, HAROLD D., Chicago
● HOLTHE, RAYMOND E., Washington
HOWARD, VINCENT R., Elmhurst
JANOSOV, ROBERT D., Peoria
KYRIAZIS, PETER D., Chicago
LINCICOME, THOMAS N., Elgin
PAYNE, HARRY J., Metropolis

Indiana

CALENOFF, RAYMOND, Kokomo
● LINDHOLM, JOHN C., Lafayette
PETERSON, WILLIAM H., Hammond

Kansas

● HARRIS, PORTER K., JR., Wichita

Kentucky

CALHOUN, JACK R., Paducah
MATHENY, ROY R., Paducah
TAYLOR, ORVILLE W., Benton

Louisiana

SAHMP, FRANCIS F., Shreveport

Maryland

BETZ, GORDON M., Towson
LEHMANN, ARTHUR A., Baltimore
PETERSON, MERVIN L., JR., Baltimore

Massachusetts

BLANK, STANLEY I., Boston
CROWLEY, JAMES A., Boston
ENGEBRETSON, CLAREMONT D., Lexington
GRISSOM, PAUL H., West Lynn
● TAYLOR, FRANKLYN H., Leominster

Mississippi

BOARDMAN, JOHN R., Pascagoula

Missouri

HADLEY, THEODORE R., Kansas City
HARRINGTON, PATRICK D., St. Louis
SECHREST, CHARLES H., Kansas City
WHITE, JAMES L., Kansas City

New Hampshire

ESTRADA, HERBERT, JR., Hampton

New Jersey

● AGOSTA, VITO D., River Edge
BARTA, DAVID D., Westfield
● KIRSCH, GEORGE A., Paramus
PAYNE, RAYMOND, Harrison

SCHACHTER, MICHAEL L., Paramus
SNYDER, HERMAN, Paterson

New York

●ANDERSEN, CARL P., Tonawanda
ASPELUND, LLEWELLYN F., Brooklyn
●BOW, WILLIAM J., Congers
BROWN, DONALD K., Olean
BRYSON, DONAL A., Buffalo
CODERRE, WILLIAM J., W. Islip, L. I.
DOLL, EMIL, Glendale
DUNHAM, BERT L., Lake View, Erie Co.
GEIST, CARL A., Buffalo
HESS, NATHANIEL J., Hicksville
LOWE, HOWELL C., West Hurley
MYTCHAK, PETER, Olean
O'HARA, ARTHUR C., Syracuse
PETTERSON, ALBERT A., Chappaqua
●RAUHE, MARY L., Endicott
TSUI, CHUNG Y., Corning

North Carolina

HUTCHINS, ERLE M., Winston-Salem

Ohio

BETTS, KENNETH G., Middletown
GROFF, JOHN R., Springfield
JENKINS, ROBERT W., JR., Cleveland
RAMBERT, CLARENCE D., Cincinnati
SCHAFFER, ROBERT H., Cincinnati
TARWINSKI, MARIAN J., Mount Vernon
WHITTLE, JAMES, Perrysburg
WOJTOWICZ, ANATOL, Dayton
WUNDER, ERWIN R., Mount Vernon

Oklahoma

●GLASGOW, CLARENCE O., Tulsa

Oregon

JOHNSON, LEROY W., Portland
LEONARD, MILTON K., Portland
●PORTOUW, ROBERT C., Portland
TWOMBLY, HARRY F., Portland

Pennsylvania

GLASS, RICHARD D., Levittown
HARKNESS, ALBERT W., McKeesport
●MOMOSE, KIYOHIRO T., Reading
PLACE, GEORGE W., JR., Philadelphia

Rhode Island

●DUZICH, JOHN J., Pawtucket

South Carolina

SMITH, STANLEY E., Aiken

Texas

ALPERT, LEONARD S., Houston
HEBB, JERRY L., Texas City
MENGER, WILLIAM M., Houston
PATTY, WILLIAM P., Houston

Utah

BANKS, HENRY P., Salt Lake City

Vermont

●PATTERSON, HENRY B., Springfield

Washington

LOVE, WILLIAM J., Richland
SMITHERS, ROBERT M., Richland

West Virginia

BREDIMUS, FRANKLIN B., Belle
PATTON, CHARLES E., Charleston
SELLEW, WILLIAM W., JR., South Charleston

Wisconsin

GENTHE, WILLIAM K., Milwaukee
STURM, HELMUTH, Kenosha

Foreign

CAMPOS, CRISANTO E., Oriente, Cuba
MONTALTO, RENATO, Zulia, Venezuela
MUSZYNSKI, EDWARD J., Montreal, P. Q., Canada
SZPARAGA, DONAT P., Malton, Ont., Canada

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	29 East Madison St.	57 Post St.

Men Available[1]

Chicago Office

Product, Development Engineer, BSME, LLB, Business Management; 34; sound background in product development and new product promotional activities with administration ability; ten years' varied experience with many types of mechanical components. Interested only in progressive firms. Location immaterial. Me-1054-Chicago.

Chief Engineer, BSME; 38, supervisory experience in both design and maintenance. Over ten years' experience in design, development, and maintenance on equipment within paper and related process industries. Prefers South or Midwest. Me-1055-Chicago.

Plant Manager, BSME; 33; 13 years proved success in production management and R&D administration in big industry. Varied experience in paper, electronics, and railroad-transportation equipment fields. Prefers Midwest or West Coast. Me-1057-Chicago.

Plant Engineer, BSME; 38; 14 years estimating, design, specification, contracting, and construction of all types of facilities for large Midwestern manufacturing company. Seeks growing organization placing emphasis on individual initiative, creativity, and honesty. Midwest preferred. Me-1058-Chicago.

Chief Engineer or Foreign Operations Manager, BSME; 36; 12 years' experience in design of high-precision products, special equipment, tools, and machinery. Supervision of engineering department, development labs, tool room, and model shop. Patent experience. Foreign operations establishment and co-ordination. Familiar with European standards. Fluent German. Midwest preferred. Me-1060-Chicago.

[1] All men listed hold some form of ASME membership.

Engineer, 39; recent graduate with BS(ME) with a minor in industrial engineering; 12 years' experience on gasoline and diesel engines; this also includes some supervision, welding (gas), electrical, plumbing, and machine-shop work. Location dependent upon opportunities. Me-1062-Chicago.

Project Engineer, BSME, PhD; 39; seven and a half years design and project engineering in power plant and refinery work; three years research and computer programming. Has designed piping flexibility, power-station heat balance, and compressible-flow programs. Prefers Midwest. Me-1065-Chicago.

Project Engineer, Design and Development Engineer, BME; 30; five years' experience in R & D involving engine and compressor work, machine dynamics, hydraulic seals, control systems, and instrumentation. Responsibilities included analysis, construction, and laboratory development. Prefers Midwest. Me-1066-Chicago.

Senior or Development Engineer, RPE Ill., BSME; 37; 15 years' experience in steam-electric plant design, chemical-plant engineering, and manufacturing power-plant equipment. Sound engineering background, demonstrated administrative ability. Prefers special equipment manufacturing. Will travel. Prefers location. Me-1067-Chicago.

New York Office

Sales or Marketing Manager, MBA, ME, nine years' experience in marketing and sales management; four years as foreign sales manager. Selection of distributors, advertising, promotion, etc., in basic materials. $15,000. Location immaterial. Me-799.

Power Plant or Plant Engineer, Superintendent of Maintenance or Process Engineer, BS in general engineering; 57; 30 years as steam engineer, chief maintenance engineer, power-plant supervisor, superintendent of maintenance in major steel, chemical, and powder plants. Prefers South. Me-800.

Sales Engineer or Manufacturing Management, BSME, PE; experienced in the development of manufacturing processes and preparation for production of new items, plastic and metal. Co-ordination of activities of process engineers, machine and tool designers, inspection, production control, purchasing and product designers; train operators, set-up men, maintenance men, etc. Prefers N. J.; will consider other eastern locations. Me-801.

Mechanical Engineer, MSME; 39; marketing, design and research experience in bulk materials handling, power plants, dust-control equipment, in U. S., Europe. Fluent German, some French. Good personality, appearance, executive ability. $11,000. Prefers East, Chicago, or West Coast. Me-802.

General Manager, BSME; 37; 17 years' experience in sheet metal, design, fabrication, installation, estimating, management, contracts (HVAC shop). $15,000. Location open. Me-803.

Industrial Manager, BS. Industrial Management; 40; 18 years' experience in metal-working industry in positions of process engineer, project engineer, plant engineer, production superintendent, manufacturing manager, and assistant to works manager. Will relocate. Me-804.

Assistant General Manager, BSME plus graduate studies; experience in planning, development, and evaluation of automatic machinery, processing equipment and control-system components; estimating and controlling development costs and schedules. Location immaterial. Me-805.

Sales Manager, ME, PE; strong background controls instruments, valves, power-plant equipment, fuels, and handling. Calling on consulting engineers, industry in metropolitan New York City, N. J., and Conn. Prefers regional, will consider national accounts. $14,000. minimum. Prefers East. Me-806.

Administrative or Contract Liaison Engineer, ME; 43; 20 years' experience in steam-power plant equipment, fabrication of components, manufacture, project planning and control, plant layout, job-site co-ordination. British apprenticeship. U. S. citizen. $9500-$10,500. East or Fla. Me-807.

Plant Manager or Works Manager, degree in mechanical and industrial engineering; 14 years' experience as chief engineer, assistant to plant manager, and factory manager in small and medium-sized companies manufacturing metal stampings and metal and plastic closures. $13,200. Prefers South, Southwest, or West. Me-808.

Facilities Engineer, BSME; 16 years' experience as a mechanical engineer. Full charge of all design, maintenance, and operation of power plant, air conditioning, plumbing, etc. $10,000. New York, N. Y. Me-809.

Positions Available

Chicago Office

Research Engineer, graduate mechanical or civil, at least two years' experience in the development of new products, structural analysis, and design. Knowledge of structural theory, stress analysis, applied mechanics. Duties will include product development in structures, heavy equipment, transportation, and materials-handling equipment. Must be able to direct development work from conception through analysis and experi-

ment to production stage. Creativity, analytical ability, and co-operation with production and marketing personnel desirable. Company manufactures metal and plastic. To $12,000. Employer will pay placement fee. Chicago Loop. C-7984.

Supervisor, Engineering Research, graduate mechanical, about 40, seven years' experience in machinery design and/or production engineering. Knowledge of pulp and paper industry desirable. Will develop and supervise small research group on equipment requirements for new processes and pilot-plant design. Must have exceptional creative ability. Products are mostly building materials. Some travel. $10,000–$12,000. Employer will pay placement fee. Chicago, Ill., area. C-7978.

Industrial Engineer, MS or IE, PhD preferred, reg. PE, 35–50, to teach industrial engineering in north Midwestern state. Opportunity for R & D and to become chairman of department. Starting salary, $7000. Excellent living conditions in progressive community. C-7965.

Regional Sales Engineering Manager, graduate mechanical preferred, 30–50; five years' sales experience; knowledge mechanical-engineering trades and construction. Will supervise sales and engineering activities of a group of distributors, call on architects and engineers promoting radiant systems. Will train distributor salesmen; travel, home week-ends; car required. Company manufactures radiant heating and cooling systems. $8000–$12,000. Employer will negotiate fee. Ill. C-7962.

Architecture-Mechanical Engineer, graduate mechanical, 25–57; five years' experience in mechanical engineering and air conditioning, with two years' supervisory responsibility. Must know heating, ventilation, air-conditioning, and plumbing work as applied to building construction. Will prepare drawings and specifications, check work with other architects and engineers, supervise building installations, and consult with other division personnel relative to afore-mentioned mechanical and air-conditioning work involving new building, remodeling, and improvements for educational institution. $8000–$10,000. Ill C-7961.

Plant Superintendent, mechanical, some courses in metallurgy, to 45; at least five years' experience as foundry superintendent on centrifugal casting preferred. Experience as foreman of superintendent of a machine shop, job shop, and working with large lathes and boring mills. Will be responsible for supervision of foundry and machine shop of about 100, maintenance superintendent, shipping foreman, production-control supervisor, purchasing and stores supervisor, personnel and labor-relations assistant. Basic responsibility will be to establish and maintain an effective plant organization and to maintain mutually satisfactory relations with the union. To produce quality nonferrous and cast-iron castings in the most economical manner possible and to machine them to customers' specifications; to maintain the physical plant. Must be willing to live in small Midwestern town. Employer will pay placement fee. C-7953.

New York Office

Chief Industrial Engineer, mechanical or industrial graduate, at least five years' supervisory industrial-engineering experience covering methods, production layout, cost analysis, cost reduction, etc., in aircraft or allied fields. $12,000–$18,000. New England. W-8745.

Engineers. (*a*) Mechanical engineers, two to eight years' experience in mechanics related to packaging, printing, and other related types of manufacturing. Positions include both mechanical design and equipment maintenance. Upstate N.Y. (*b*) Industrial engineers, two to five years' experience for positions in packaging and automated manufacturing operations. Should have experience in cost reduction, production-control standards, engineering methods. Upstate N. Y. and Ohio. W-8741.

Industrial Engineer, graduate industrial or mechanical, three to seven years' experience in industrial engineering, preferably in heavy industry (steel or chemical); part in work measurement, job evaluation, methods, equipment justification, etc. Exceptional opportunity. $7500–$9000. Eastern Canada. W-8733.

General Supervisor, Building Services, degree in engineering, five or more years' experience in supervision and administration within the construction and building-maintenance fields. Will be responsible for all up-keep and maintenance of a large group of buildings, including supervision of custodian and security groups; checking all plans for space and facilities projects. Also responsible for administering purchases of outside services such as electricity, steam, and telephone service. $8000–$10,000. Mass. W-8729(*a*).

Mechanical Engineers, experienced, for product design and application studies with large steel manufacturer. Work involves design of steel products, engineering studies relating to application of steel products in all fields. Must have strong theoretical background. Salary open. East. W-8718(*b*).

Mechanical Engineer, graduate, gear experience for gearing problems on subfractional hp motors. $7800–$9000. Mass. W-8713.

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members; $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

Research and Development Engineer, BSME, to 40, for design and development of new equipment in pulp and paper and in the general field of solid and liquid separation. $8500–$9500. Company pays placement fee. Mass. W-8711.

Designer, graduate mechanical engineer, whose work has included hydraulic as well as mechanics. Must be capable of making stress analyses of machine linkages. Good engineering background and production sense required. Apply by letter giving complete résumé including salary requirements. Conn. W-8707.

Quality-Control Manager, successful record of quality-control experience in a company manufacturing mechanical, electromechanical, or electronic products in reasonably large quantities. Will be responsible for all quality-control functions from incoming raw materials through finished goods. Products involve a variety of stampings, die castings, plastic moldings, finishes, and assembly operations. $10,000, to start. New York Metropolitan area. W-8699.

Standards Engineering Manager, graduate industrial engineer, at least ten years' experience in the industrial-engineering field. Will be responsible for establishing and maintaining work standards and incentives; will supervise approximately 30 employees. $9000–$10,000, to start. Upstate N. Y. W-8679.

Engineers. (*a*) Materials Engineer to compound and test elastomers for various tire applications. Rubber-compounding experience desirable. Salary open. (*b*) Tire engineer, MS or PhD in physics or mechanical engineering, to study fundamentals of tire construction and performance, stress analysis. Will accept recent graduate up to five years' experience. $6000–$10,000. (*c*) New products research engineer, graduate mechanical, to work on product design—static and kinetics—re brakes, de-icers, space suits, missiles-motor cases, rocket nozzles, V belts, in rubber goods. $8000–$10,000. Midwest. W-8672.

Sales Engineers, 25–40, mechanical engineering or equivalent background, interested in selling and demonstrating spray equipment designed for the application of epoxy, polyurethane, and polyester resins. Should be familiar with the plastics industry, mainly epoxy resins. Considerable travel; company furnishes car. Salary open depending upon background and experience Headquarters, N. J. W-8661.

Chief Engineer, graduate mechanical, master's in instrumentation and control desirable; experience in systems engineering in instrumentation manufacturing, application engineering, sales management, and supervisory background desirable. Will design and apply instrumentation systems for power and process applications; act as liaison agent with companies manufacturing systems; supervise estimating and service department, etc. $10,000, plus profit participation. New York, N. Y. W-8656.

Mechanical Engineer, for an architectural firm, experienced in design and co-ordination of heating, ventilating, air conditioning, and plumbing for normal building design. Will be required to co-ordinate the work of consulting engineers with the work of architects. To $9880. N. J. W-8639.

Engineers. (*a*) Assistant to chief design engineer, 35–45, graduate mechanical, experience in high-speed, semiautomatic, medium machine equipment, i.e., packaging machinery, plastic extruding machines, etc. $12,000–$13,000. (*b*) Machine designer to project engineer, experienced as afore-mentioned. $8000–$12,000. Mass. W-8631.

Plant Manager, for management and production in a plant manufacturing lime. Salary open; 100 per cent company contributory retirement and latest comprehensive group insurance. Apply by letter submitting complete résumé. South. W-8619.

Supervisor of Maintenance, graduate mechanical, about five years' experience in plant maintenance; experience in preventive maintenance desirable, for company manufacturing pharmaceuticals. Department consists of three professional men and 40 to 50 men in the trades. Should have considerable potential as opportunity for advancement is excellent. $10,000–$12,000. Company will negotiate fee. N. J. W-8600.

Production Controls Engineers, experience in production control and related activities such as traffic and expediting. Will consider recent college graduates with or without technical degrees. Salaries: for an experienced production control engineer, $7800–$8400; for recent graduates, competitive with leading firms throughout the U. S. Company negotiates relocation and agency fees. Upstate N. Y. W-8595.

Production Engineers, for a manufacturer of die-cast and metal-stamped automotive accessory parts. (*a*) Die-Cast production engineering, mechanical graduate preferred, with experience in tooling, estimating, manufacturing of die-cast zinc-aluminum parts. (*b*) Sheet-metal production engineering, graduate mechanical preferred, experience in designing, tooling and getting tools into production. Salaries open. Company will negotiate relocation and agency fees. Either upstate N. Y. or Ohio. W-8594.

Teaching Personnel for general engineering department of a university; young; MS in a branch of engineering, or interested in work toward MS or PhD. Must be interested in teaching. Midwest. W-8578.

Senior Industrial Engineers, for positions at management level. (*a*) Industrial engineer in the field of indirect standards; to supervise the development of a standards program for departments such as tool and die and maintenance. Must be experienced and able to give technical guidance and direction at project level. MTM training desirable. (*b*) Industrial engineer with experience in the installation of MTM standards program in a direct labor department. Must be an accomplished MTM practitioner capable of giving technical guidance and direct on to a group of industrial engineers recently trained in MTM. To $9600. Ohio. W-8577.

Sales Manager, engineering graduate, at least five years' supervisory field sales, sales promotion, market research, and product development experience in thermoplastic molding and impregnated fields. $10,000–$15,000. Mich. W-8570.

OBITUARIES

James Ira Banash (1885–1960), consulting engineer, Los Angeles, Calif., died Jan. 10, 1960. Born, Boston, Mass., July 20, 1885. Parents, Harry and Bertha Banash. Education, SB, Massachusetts Institute of Technology, 1906. Married Miss Rowe, 1920. Mem. ASME, 1927; Fellow ASME, 1950. Mr. Banash received the James Turner Morehead Medal for 1949 for his contributions to the acetylene industry. He was the author of numerous papers on oxygen therapy, liquefied petroleum gases, and various uses of containers for compressed gases. Mr. Banash was past-chairman of the American Society of Safety Engineers Section of National Safety Council, and past-president of the National Safety Council. He was a founder of AWS and a member of National Fire Protection Association, International Acetylene Association, and the Association of American Railroads. His wife, Mrs. Ceil Banash, survives him.

William Otto Becker (1902–1959), staff industrial engineer, Mergenthaler Linotype Company, Brooklyn, N. Y., died Oct. 10, 1959. Born, Brooklyn, N. Y., April, 11, 1902. Parents, John Frank and Tena Becker. Education, ME, Polytechnic Institute of Brooklyn, 1929. Married Theresa Doherty, Sept. 13, 1936, and had two daughters. Mr. Becker worked extensively in methods, time study, and tool design. He obtained a patent for a linotype machine mechanism, designed an electronic comparator, and developed a novel broaching technique. He was responsible for the establishment of an Industrial Engineering Reference Manual for which he developed charts that were published in *Production*, *Tooling and Production*, and *Metalworking*. Jun. Mem., ASME, 1929; Mem. ASME, 1950. Member also of American Ordnance Association.

Frank George Boyce (1885–1959), retired,

formerly vice-president, Consumers Power Co., Jackson, Mich., died Oct. 31, 1959. Born, Philadelphia, N. Y., Feb. 8, 1885. Parents, Ormsby Jefferson and Catherine (Kenney) Boyce. Education, Bliss Electrical School, 1907. As vice-president of Consumers Power Co. Mr. Boyce was in charge of production, transmission, and construction of new steam-electric generating plants, steam-heating plants, hydroelectric plants, and electric substations. He had been with The Milwaukee Electric Railway & Light Co. and Goodyear Tire & Rubber Co. Mem. ASME, 1921; Fellow ASME, 1921. Member also, AIEE, Michigan Engineering-Society and Detroit Engineering Society. His wife, Margaret, died Feb. 19, 1959.

Robert Enoch Bryant (1890–1959), retired, formerly of Eastern Malleable Iron Co., Wilmington, Del., died Nov. 30, 1959. Born, Braintree, Mass., Oct. 6, 1890. Parents, Enoch Chase and Clara (Keith) Bryant. Education, ME, Massachusetts Institute of Technology, 1911. Married Ethel L. Mulliken in 1913; children, Richard Whitney Bryant and Lois Cutting Bryant. Jun. Mem., ASME, 1919; Assoc. Mem., ASME, 1952; Mem., ASME, 1959. He was a member of the ASME Sectional Committee on Standardization of Pipe Flanges and Fittings. Mr. Bryant was past-president of Lockport Fittings Co. and was active in standardization of pipe fittings and malleable iron castings. As a member of the American Foundryman's Association he served on the International Relations and the Advisory Committees. He was also a captain in the Ordnance Department of the U. S. Army.

George Dewey Carpenter (1882–1960), retired, formerly superintendent of Water and Sewer Dept., Ithaca, N. Y., died Jan. 15, 1960. Born, Lansing, Mich., Aug. 2, 1882. Parents, Rolla C. and Marion D. Carpenter. Education, ME, Cornell Univ., 1906. Mem. ASME, 1919. Married Lulu Blanchard June, 1907. He is survived by his wife, four nieces, and a nephew.

Roland Emanuel Cernea (1900–1959), chief engineer, Pennsylvania Forge Co., Philadelphia, Pa., died Nov. 18, 1959. Born in Roumania June 6, 1900. Education, AB, Roumanian, Lyceum, 1918; Massachusetts Institute of Technology, 1925. Mem. ASME, 1941.

Charles Douglas Galloway (1881–1960), retired, formerly manager of plant engineering, The Electric Storage Battery Co., Philadelphia, Pa., died Jan. 3, 1960, Chestnut Hill, Pa. Born, Washington, D. C., Jan. 15, 1881. Education, Central High School, Washington, D. C. During his career, Mr. Galloway obtained 20 patents mainly for developments in machinery for battery manufacture including a leak-proof vent plug for mine batteries. Another invention, an electric mining lamp, the first to use a free electrolyte storage-battery for power, was the third approved by the U. S. Bureau of Mines. He received the U. S. Naval Ordnance Development Award for outstanding work on electric-torpedo batteries. As member of The Franklin Institute Committee on Science and the Arts, he received its George A. Hoadley Certificate for 35 years of devoted service. Mem. ASME, 1913. He is survived by his wife Emily (Gray); a daughter, Mrs. Jane Grove; a son, C. Douglas, III; four grandchildren and two great-grandchildren.

Robert F. Golden (1888–1959), retired, formerly of the National Lock Washer Co., Newark, N. J., died Dec. 19, 1959, Riverton, N. J. Born, Columbus, Ga., July 13, 1888. Education, BS-(ME), Georgia School of Technology, 1911. Mem. ASME, 1930. Member also, American Society for Steel Treating.

William Gillum Heltzel (1895–1959), consulting engineer, Tulsa, Okla., died Dec. 3, 1959. Born, Ellerslie, Md., March 9, 1895. Education, BS, Carnegie Institute of Technology, 1918. Parents, William M. and Mary (Carpenter) Heltzel. Widely recognized for his work in hydraulics engineering, Mr. Heltzel wrote extensively on phases of petroleum engineering. An article published in *Oil and Gas Journal* became the basis for a hydraulic slide rule, now in general use in industry. He did engineering work for the crude-oil line connecting Algeria's Hassi Messaoud field with the Mediterranean. He was vice-president and general manager of Stanolind Pipe Line Co., now Service Pipe Line. During World War II, Mr. Heltzel served as adviser to the U. S. Army on military pipelines. He sponsored the first corrosion studies for underground pipelines at the 1926 ASME meeting in Tulsa; and served as chairman of the ASME committee performing the actual work of designing, installing, and demonstrating the automatic pumping station at the International Petroleum Exposition, Tulsa, 1929. Assoc. Mem. ASME, 1924; Mem. ASME, 1935; Fellow ASME, 1951. Member also of American Petroleum Institute.

George Woodbury Irey (1884–1959), retired, formerly superintendent of plants and production, Empire District Electric Co., Riverton, Kan., died Nov. 5, 1959, Palo Alto, Calif. Born, Waverly, Kan., Jan. 28, 1884. Parents, Robert Lenord and Hanna (McFadden) Irey. Education, International Correspondence School, American Correspondence School, and Business Course, Alexander Hamilton Institute. Married Minnie May Reben, May 10, 1911, and had three children. Mr. Irey had many years experience with construction and operation of power, water, gas, and oil companies. His articles have appeared in *Combustion*, *Harvard Review*, *Electrical World*, MECHANICAL ENGINEERING, *Engineering News*, *GE Review*, *Oil and Gas Journal*, and *Electrical Engineering*, among others. Mem. ASME, 1930. Member also of AWS, AIEE, ASTM, ASM, NSPE, and Great Lakes Advisory Board. Past-president, Lions Club, Lorain, Ohio.

Frederick Raymond Jackson (1893–1959?), designer, Duke Power Co., Charlotte, N. C., is deceased according to notice recently received by the Society. Born, Pawtucket, R. I., March 31, 1893. Education, high school and night drawing school, Pawtucket, R. I. Jun. Mem. ASME, 1917; Assoc-Mem. ASME, 1924; Mem. ASME, 1928.

Rodrigue Albert Jeheber (1902–1959?), research and development engineer died recently. Born in Geneva, Switzerland, March 13, 1902. Mr. Jeheber became a naturalized U. S. citizen in Pittsburgh, Pa., 1932. Parents, Jean Henri and Anita Jeheber. Education, College of Geneva, 1920; Diplom ME, Federal Technical University, Zurich, Switzerland, 1924. Mr. Jeheber spent many years with Wilson-Snyder Manufacturing Corp. as assistant chief engineer. Jun. Mem. ASME, 1927; Mem. ASME, 1935. Member also ASM.

Glen Fay Jenks (1880–1960), retired colonel, U. S. Army, died Jan. 1, 1960, San Diego, Calif. Born, Deansboro, N. Y., June 13, 1880. Parents, Dwight E. and Lillie (Hewitt) Jenks. Education, BS, Hamilton College, 1901; MS, 1904; Army War College, 1924; MBA, Harvard University, 1930. Married Cecil Lane, 1920. During his army career Colonel Jenks served in both world wars. He received the Legion d'Honneur from the French government and the U. S. Distinguished Service Medal. For ten years he was commandant of Watertown, Mass., Arsenal. He was a founding member of the Army and Navy Club, Washington, D. C. After retirement, he was technical consultant for North American Aviation Co., Los Angeles. Jun. Mem. ASME, 1909; Mem. ASME, 1914. Member also of ASTM, ASM, AWS, SAE, AIME, AMA, Army Ordnance Association, and Fellow, AAAS. He leaves his widow; a daughter, Mrs. Wolf Zuelzer, Detroit, Mich.; a son, Walter, Akron, N. Y.; and two granddaughters.

Alfred LaBissoniere (1899–1960), chief inspector and chief examiner, Department of Labor, Quebec, Canada, died Jan. 3, 1960. Born, May 27, 1899, Batiscan, Que. He was a citizen of Canada. Education, College St. Joseph, Berthierville, Canada, 1917; Technical School of Three Rivers; Combustion Engineering Degree from International Correspondence School, 1931. Mem. ASME, 1956. Mr. LaBissoniere was also a member of Canadian Standards Association and the executive committee of the National Board of Boiler and Pressure Vessel Inspectors.

Robert Black Philson (1936–1959), mechanical engineer, Pratt & Whitney Aircraft Co., E. Hartford, Conn., died Somerset, Pa., Oct. 10, 1959. Born, Somerset, Pa., April 14, 1936. Parents, Robert and Elizabeth (Black) Philson. Education, BS(ME), Carnegie Institute of Technology, 1958. He was the recipient of the Andrew W. Mellon Scholarship. Assoc. Mem. ASME, 1958.

Stephen Frank Pusateri (1924–1959), project engineer, Hagan Corp., Pittsburgh, Pa., died Dec. 8, 1959. Born Pittsburgh, Pa., Nov. 15, 1924. Parents, Frank and Lena Pusateri. Education, BS(ME), Carnegie Institute of Technology, 1952. Married Romilda Sciullo, Sept. 10, 1952. Assoc. Mem. ASME, 1952. He is survived by his wife and a daughter, Christina.

Clinton Henry Quirk (1880–1959), retired ventilating engineer, formerly with the Public Works Div., U. S. Navy, New York City, died Dec. 20, 1959. Born, Binghamton, N. Y., Nov. 17, 1880. Parents, William Martin and Anna (Ayers) Quirk. Education, high school and special mechanical-engineering studies. Married Maude Allerton in 1905. Mr. Quirk was integral in designing and building special high-temperature blowers for cinder separation in stacks. Assoc. Mem. ASME, 1917; Mem. ASME, 1935. Member also, ASHAE. He is survived by his daughter, Mrs. Barbara Conley, Hempstead, N. Y.

Joel A. Raphael (1936–1959), research engineer, Revere Copper & Brass Co., Brooklyn, N. Y., died Nov. 23, 1959. Born, Brooklyn, N. Y., April 20, 1936. Education, BS(ME), Rensselaer Polytechnic Institute, 1958. Assoc. Mem. ASME, 1958.

Ermel Grady Stepp (1902–1959), manager of the Compressor Dept., Charleston Group Companies, Columbia Gas System, Inc., Charleston, W. Va., died Dec. 19, 1959. Born Pilgrim, Ky., Sept. 21, 1902. Mr. Stepp was in charge of operation and maintenance of compressor plants for many years. Mem. ASME, 1952.

Frank Edwin Stirn, (1912–1958), director of product research and development, American Cyanamid Co., Pearl River, N. Y., died Oct. 9, 1958. Born, Arcadia, Wis., Feb. 7, 1912. Education, BS, University of Wisconsin, 1933; PhD, 1938. During Dr. Stirn's career in the field of pharmaceuticals, chemicals, and allied products, he was responsible for co-ordinating mechanical and chemical processes, laying out process equipment. He received more than 25 patents. Affiliate ASME, 1958. Member of ACS and N. Y. Academy of Sciences.

Harvey Birchard Taylor (1882–1959), retired shipbuilding executive, engineer, and designer of turbine machinery died Dec. 30, 1959, Newton Square, Pa. Born, Philadelphia, Pa., Nov. 30, 1882, he was the great-grandson of William Cramp who founded a world famous shipyard. Parents, Charles Tracy and Sophie Cramp Davis Taylor. Education, BS(ME), University of Pennsylvania, 1930 (granted as of 1905); honorary ME degree, University of Pennsylvania, 1931. In 1938 he received their Alumnae Award of Merit. He began his career in his family's business, I. P. Morris Co., a subsidiary of Wm. Cramp and Sons Ship and Engine Building Co. He supervised the manufacture of turbines for water-power developments at Niagara, Keokuk, Muscle Shoals, and Conowingo in this country and Cedars Rapids and Shawinigan in Canada. Mr. Taylor was president of Cramp-Morris Industrials, Inc., Federal Steel Foundry Co., I. P., Morris and De La Vergne, Inc., Pelton Water Wheel Co., and Cramp Brass and Iron Foundries Co. In 1952, The Franklin Institute presented him with the Elliott Cresson Medal for his leadership in the development of the single runner vertical turbine, his many patents, and his contributions to technical literature. Mr. Taylor was president of the Navy League of the U. S., a former trustee of the University of Pennsylvania, director of the Philadelphia Bourse, member of the board of directors of the Research Institute of Temple University, member of the Guild of Bracket Lecturers of Princeton University, and past-president of the Diesel Engine Manufacturers Association, among others. Jun. Mem. ASME, 1910; Mem. ASME, 1913; Fellow ASME, 1937. Member also, AIEE, ASCE, and The Franklin Institute. He is survived by his second wife, Clarice Paterson Taylor; two children, five grandchildren, and three great-grandchildren.

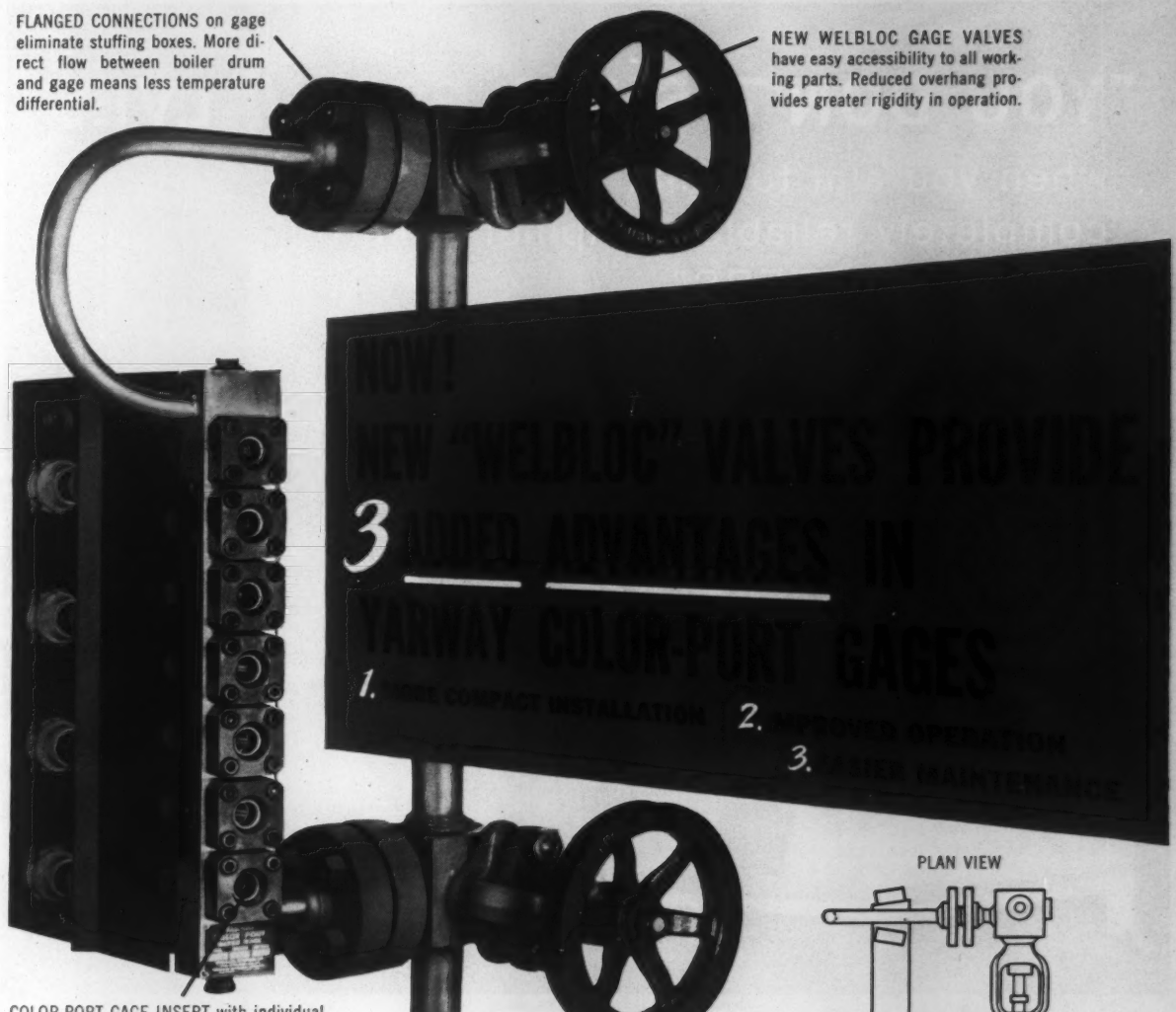
Charles Clarke Wales (1900–1959), chief project engineer, National Tube Co., Pittsburgh, Pa., died Dec. 23, 1959, Bay Village, Ohio. Born, Sharon, Pa., July 25, 1900. Parents, Albert E. and Anne J. Wales. Education BASc, University of Toronto, 1924. Married Miss Gritz, Sept. 26, 1931. Assoc-Mem. ASME, 1930; Mem. ASME, 1935. Member also AISE and Cleveland Engineering Society.

Charles Frederick Wieland (1867–1959), retired consulting mechanical and structural engineer, died Dec. 9, 1959, Berkeley, Calif. Born, St. Louis, Mo., Oct 10, 1867. Parents, Charles A. D. F. and Agnes (Bollman) Wieland. Married Myrta Louise Bennett, Oct. 11, 1894. Mr. Wieland received patents on his inventions of pipe-threading machines and pipe-wrapping machines which now bear his name. He served in the U. S. Army in World War I and held the rank of Lieut. Colonel (retired) in the reserves. Mem. ASME, 1901. Member also of the American Legion, the World Affairs Council of Northern California, and the Commonwealth Club.

Herman Frederick Willkie (1890–1959), former meat-packing and distilling-industry executive, Indianapolis, Ind., died Dec. 28, 1959, in Oshkosh, Wis., of a heart condition. He had been ill six years. Born, Elwood, Ind., Sept. 30, 1890, he was the brother of the late Wendell Willkie, 1940 Republican presidential candidate. Parents, Herman Francis and Henrietta (Trisch) Willkie. Education, AB, Indiana University, 1912. He held honorary doctor-of-laws degrees from University of Louisville and Indiana University. Married Helen F. Hall. Mem. ASME, 1947. Beginning in 1927, he was with Hiram Walker & Sons, Ltd., for ten years, rising to production manager and vice-president. He was vice-president in charge of production and director of Joseph E. Seagram & Sons, Inc., and director of Distiller's Corporation-Seagrams, Ltd. He brought about the establishment of the Seagram organization's international fellowships, under which almost 150 foreign students have been brought here for technological training. Willkie was an inventor; he held 19 patents, mostly in chemical and distilling processes, and was credited with devising an industrial-alcohol process used throughout the world, a gasoline additive, and a form of plastic leather. He was the author of several articles, pamphlets, and books on subjects ranging from chemistry and agriculture to industrial management and education. He was chairman of the Rural Medical Scholarship Fund, which raised $150,000 to educate doctors for rural Kentucky. The Kentucky Postwar Advisory Planning Commission, appointed by the governor in 1944, elected Willkie chairman. His committee recommendations resulted in the creation of the Kentucky Chamber of Commerce and of the State Agricultural and Industrial Development Board. Surviving him are his wife, four children, a brother, and a sister.

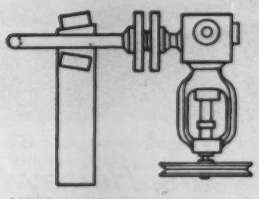
FLANGED CONNECTIONS on gage eliminate stuffing boxes. More direct flow between boiler drum and gage means less temperature differential.

NEW WELBLOC GAGE VALVES have easy accessibility to all working parts. Reduced overhang provides greater rigidity in operation.



COLOR-PORT GAGE INSERT with individual "floating assembly" ports featuring large diameter ports, reduced maintenance, brilliant red and green boiler level readings.

PLAN VIEW



MORE COMPACT DESIGN reduces installation space requirements up to 40%. Note: illuminator may be mounted on either face of gage insert.

Yarway's latest improvement in boiler water level gage design—"WELBLOC" GAGE VALVES—gives you these new advantages:

SIMPLIFIED INSTALLATION—Close-coupled design reduces space requirements by 40% in the viewing axis of the gage. Whole unit weighs less, is easier to handle.

IMPROVED OPERATION—Greater rigidity when operating handwheels, because of reduced overhang. More direct flow of boiler water to gage, resulting in reduced temperature differential of insert.

EASIER MAINTENANCE—Single drain connection serves both gage and circulating tie-bar.

Couple these *3 new advantages* with the well-known standard COLOR-PORT features:

- **brilliant red and green readings**
- **increased operational time**
- **reduced maintenance costs**
- **easy method of washing out gage**

COLOR-PORT gives you the best buy in medium and high pressure water gages today. Write for the full YARWAY COLOR-PORT story.

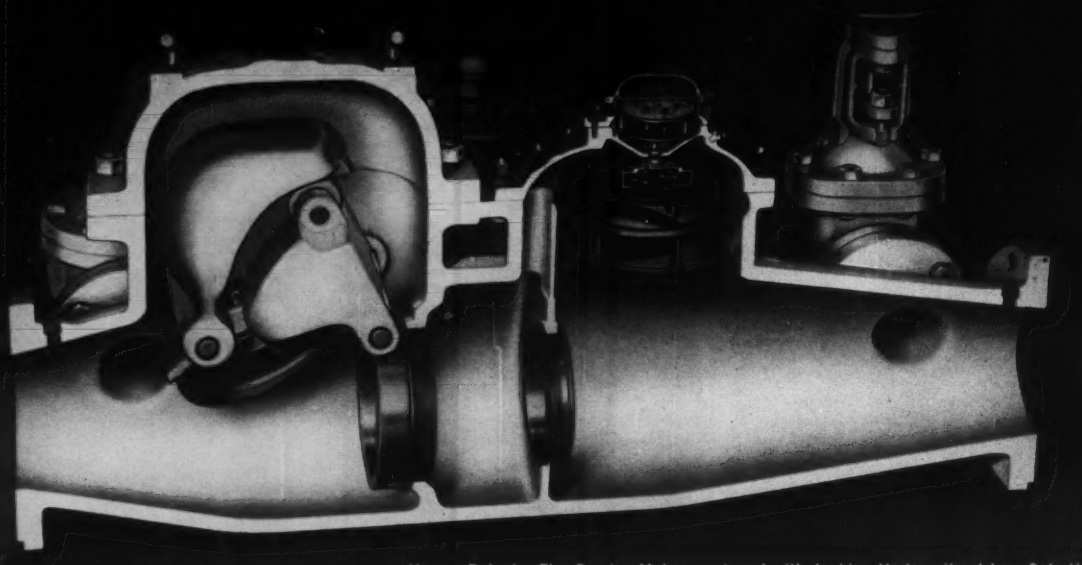
YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

"YOU DON'T SHOP FOR VALVES

when you aim to build completely reliable equipment like our HERSEY METERS"

— says Hersey-Sparling Meter Company, Dedham, Mass.
Main Office and Plant, Dedham, Mass.



Hersey Detector-Fire Service Meter, equipped with Jenkins Underwriters' Iron Gate Valve

for 35 years, Hersey Meters have been equipped with JENKINS VALVES

Century-old Hersey-Sparling Meter Company does everything possible to make good its slogan — *You can't buy a better Water Meter than Hersey*. One example is seen in a rule that any part of the meter not made by Hersey must be obtained from sources which have Hersey's own policy of making the *Best*. For valves, Hersey's standard for quality has been JENKINS for 35 years.

Hersey-Sparling's customers, like the buyers of any equipment that incorporates valves, see the famous Jenkins DIAMOND trade-mark on the valves as a sure sign that nothing has been spared in assuring reliability and low maintenance costs. Architects, engineers, contractors and operating men are bound to respect equipment that carries the valves they so often specify to assure trouble-free piping systems.

Of course, valves of less quality can be had for a little less money. But it is worth remembering that Jenkins Valves, so widely known for reliability, cost no more than any *good* valves. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS VALVES JENKINS SINCE 1864 Jenkins Bros.

MOST TRUSTED TRADE-MARK IN THE VALVE WORLD

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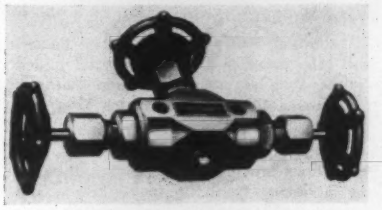
NEW EQUIPMENT



Instrument Valve Manifold

A simpler and more dependable means of making instrument connections to flow meters, level indicators, and other types of instruments is now provided by Yarnall-Waring Co. new instrument valve manifold.

It combines three valves in a single body—two providing suitable line shut-off and one equalizing pressures to protect the instrument's internal working parts—together with a connection tap for calibration of the high-pressure side of the system.

The Yarway iustrument valve manifold is furnished with either screwed or socket-weld end connections. Body and all working parts are of stainless steel. —K-1

Force Indicator

A precision force gage with a maximum capacity of 14000 grams is available from the Hunter Spring Co. The new model extends the firm's line to 26 force indicators in a variety of capacities from 0–500 grams to 500 lb.

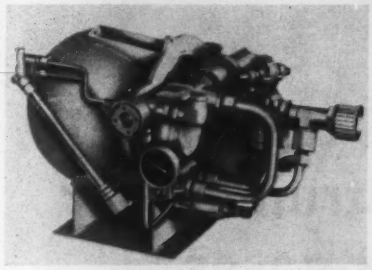
Designed for easy hand operation or for use in permanent test set-ups, the L-14000M is provided with six stainless-steel attachments for the accurate measurement of compression and tension forces. The force gage uses a compensated spring mechanism and a dial indicator with 140 divisions. The over-all accuracy is 0.5 per cent of full scale, equivalent to ±70 grams.

The L-14000M will hold the maximum dial reading after the load has been removed or follows all load fluctuations. The holding feature makes it useful for measuring momentary or transient loads, and for use in awkward positions where it is difficult to read the gage dial in the test position. —K-2

O-Rings

As a result of an intensified tooling and development program, Parker Seal Co. is now offering Viton O-rings in all ARP (AN & MS) sizes as standards.

Viton—an extremely versatile high-temperature material—according to the company has formerly been available only out of regular tooling which produced undersized O-rings or as specials. —K-3



Packaged Cooling System

A cooling system for electronic gear, announced by Vickers Inc., Div. of Sperry Rand Corp., utilizes fluorinated-hydrocarbon fluids which act as thoroughly stable dielectric and heat-transfer agents. The package system dissipates an input of 47 kw with a unit weight of 2 lb per dissipated kw. System dry weight is 74 lb.

This "active" system as compared to "passive", ablative-type cooling techniques, employs a centrifugal pump that circulates fluid through a liquid-to-air heat-exchanger core, then through the electronic gear. The fluid is circulated at rates as high as 52 gpm to maintain turbulent flow for maximum heat-transfer effectiveness. An output pressure of approximately 100 psi overcomes the inherent resistances to flow found in the coolant passages of electronic gear, and holds the fluid in a liquid state for maximum dielectric strength.

Individual-component design considerations, that is, increased output of the centrifugal pump, special pump bearings, fluid storage and fluid-level indicator, compensate for hydrocarbon fluid characteristics such as high density, low lubricity, and high coefficient of expansion.

An integral supercharge pressure control provides an operating range of −65 to +210 F. It prevents high pump-pressure output at low temperatures and pump cavitation due to fluid vaporization at high temperatures. —K-4

Air Filters

A new line of Electrostatic Air Filters made by York Div. of Borg-Warner Corp. are reported to trap between 98 and 99 per cent of all visible dust, soot, pollens, and fungus as well as $^1/_2$–$^3/_4$ of the invisible particles in the air.

Installed in forced-air ducts, the York filter requires no plumbing or drainage lines. As air passes through the filter, the charging section gives dirt and bacteria particles a positive electrical charge which causes them to be drawn and held by negatively-charged collector plates. The entire collector section can be easily removed for cleaning. The current automatically shuts off when this section is removed.

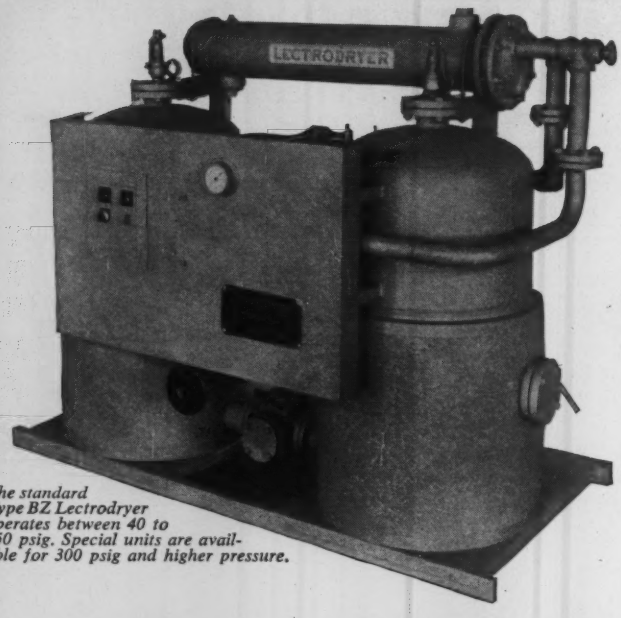
The line consists of the Models 120, 160, and 240 series, all in 115-v capacities. The dimensions of each are 22 × 20 × 21, 22 × 24 × 26, 22 × 24 × 29 respectively. The larger size handles up to 2400 cfm of air and has about 14,000 sq in. of collector-plate area. —K-5

Air Cylinders

Miller Fluid Power Div., Flick-Reedy Corp., announces that its standard line of Model-A air cylinders in $1^1/_2$ to 14-in. bores is now rated for up to 750-psi operation, depending upon bore size, as follows: $1^1/_2$ and 2-in. bores, 750 psi; $2^1/_2$-in. bore, 500 psi; $3^1/_4$-in. bore, 750 psi; 4, 5, and 6-in. bores, 400 psi; 8, 10, 12, and 14-in. bores 250 psi.

The higher ratings have no effect on the low-pressure operation of the air cylinders, which must be able to cycle smoothly at as little as 2 psi before passing the manufacturer's standard bench test before shipment. —K-6

ANNOUNCING



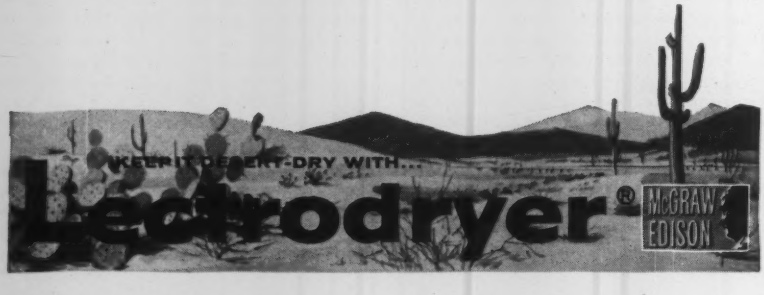
The standard Type BZ Lectrodryer operates between 40 to 150 psig. Special units are available for 300 psig and higher pressure.

NEW "BZ" LECTRODRYER for drying instrument air and other gases

For years, Lectrodryer has been known for leadership in the design and production of adsorbent dryers . . . with a reputation for providing extra peak load capacity, greater drying dependability. Now here's an even *better* dryer for compressed air and other gases—the new Type BZ Lectrodryer.

Special emphasis has been placed in the Type BZ Lectrodryer on sound but *simplified* mechanical design. It is fully automatic, supplying continuous drying with no attention other than occasional lubrication. Since the valves and valve mechanism move only a few times per day, there is virtually no wear—unlike units which cycle frequently.

Bulletin BZ-161 describes this new Lectrodryer in detail. For a copy, or for drying help, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pa.



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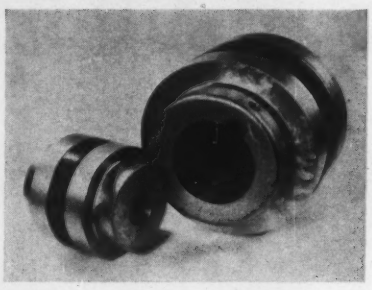

Flexible Coupling

A coupling which consists of two flanges with steel drive pins molded in and joined together by a laminated fabric and synthetic rubber disk is made by Van Gelder Mfg., Inc.

The disk is designed to transmit rated load with an ample factor of safety. The laminations provide increased strength without sacrificing flexibility or resiliency, and are designed to withstand operating temperatures up to 700 F. Special heavy-duty disks are available with woven-nylon laminations, affording unusually high strength and resistance to chemical solutions. The couplings are accurately balanced for operation at and above 3000 rpm depending upon size. Horsepower ratings are conservative and allow ample overload capacity. **—K-7**

Centrifugal Pumps

Worthington Corp. has broadened the CNG line of standard pumps with the introduction of an 8-in. and two $^3/_8$-in. Worthite centrifugal pumps. The liquid end of these pumps is constructed of all Worthite—an exclusive corrosion-resistant metal— and is available with either a standard packed-box or internal mechanical seal. The pumps are offered in both frame-mounted and monobloc design.

The 8-in. model is a twin-volute pump. Of different design than the standard line, the liquid end consists of three parts—suction cover, volute, and stuffing-box head. The stuffing-box head is designed so that a water jacket is an integral part, which will serve to either heat or cool the stuffing-box area.

Because of a double support—bearing-frame support and separate liquid-end support—the pump can be disassembled from the rear without disturbing the volute, suction head, and piping. When a packed-box pump is desired, a hooked-type Worthite shaft sleeve may be installed over the solid Worthite shaft. A split flushing gland will be standard with packing.

Low speed and high capacity make this an attractive unit for evaporator service in steel mills, paper mills, fruit-juice-concentrate industry, dye works, or the general chemical industry. **—K-8**

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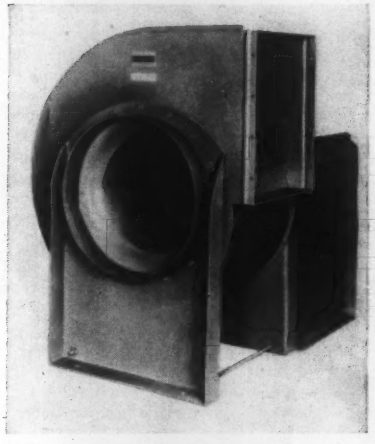


Centrifugal Ventilators

Ilg Electric Ventilating Co. has announced a new line of self-contained, belt-driven centrifugal fans featuring an entirely new principle of motor mounting. Motors and fan bearings are mounted on rubber isolation rails, eliminating vibration and resonant noise and providing extremely quiet operation. It also provides a wide range of adjustability and allows mounting of several different motor frames on one standard base.

The ventilators are designed for applications requiring low and medium ranges of volume and pressure. Twelve sizes provide capacity range from 688 to 23,000 cfm.

All fan wheels are said to be statically and dynamically balanced to insure smooth trouble-free operation. More information available in Catalog No. 3401. —K–9

All-Stainless Pressure Gages

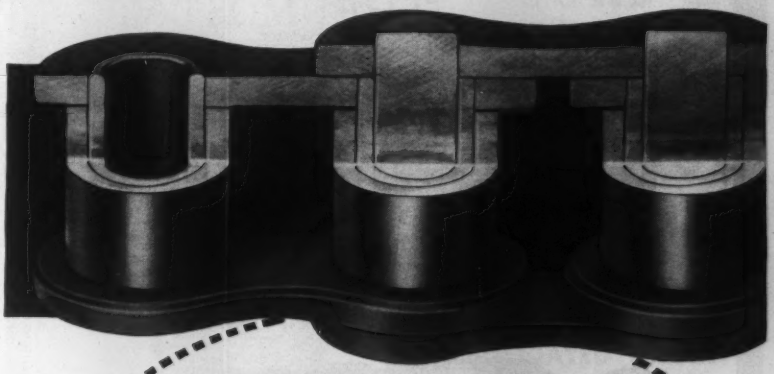
A line of drawn-case pressure gages with all components made of stainless steel is announced by the U.S. Gauge Div., American Machine and Metals Inc. The new line will find use in services involving corrosive atmospheres and media.

Type-316 stainless-steel Bourdon tube, movement, socket (welded), case, and ring are incorporated in the design. The new gage meets ASA Grade B specifications—including an accuracy of 2 per cent at the middle, or working half of scale (3 per cent for the remainder).

The line will find major uses on original equipment destined for such industries as chemical, paper, textile, petroleum, and petrochemical. Also, the line is expected to find equally important use as replacements on equipment already in service in these industries.

The new stainless-steel pressure gage is available in standard ranges up to 5000 psi and in dial sizes of 2, 2½, and 3 in. —K–10

MAXIMUM WEARING SURFACES *for longer chain life*



ACME'S SECRET *for years of additional service*

Special hardening of pins, bushings and rollers help insure maximum life expectancy of ACME Roller Chains. All parts subjective to articulation have glass-hard wear-resistant surfaces to render eminent life expectancy. The side plates or links which act as connecting members for articulating parts are specially heat treated and tempered to insure great strength and ductility.

Maximum hardening of all wearing surfaces on ACME Chains is conducive to longer life, resulting in greater economy and lower maintenance cost.

Your local distributor has a complete line of ACME Chains and Accessories on hand for immediate delivery. Call him.

See us at the Design Engineering Show
May 23–24–25–26—Booth 413

Write Dept. 11-D for new 100-page illustrated technical catalog including new engineering section showing 36 methods of chain adjustments.

Acme Chain Corporation
HOLYOKE MASSACHUSETTS

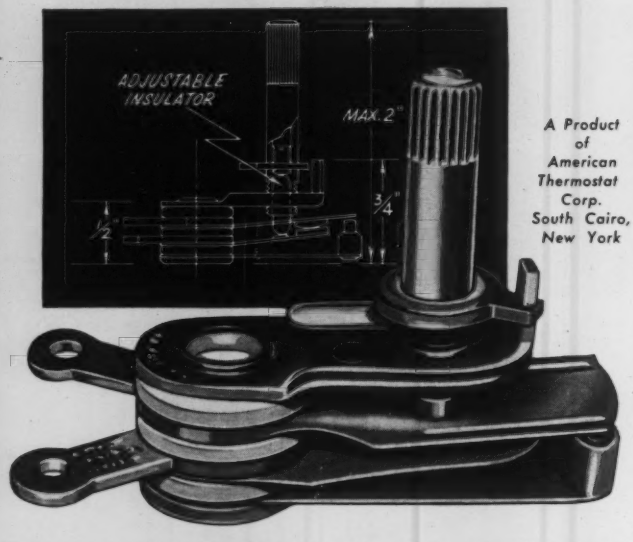
COMPLETE LINE OF ROLLER CHAINS AND SPROCKETS • DOUBLE PITCH CONVEYOR CHAINS • STAINLESS STEEL CHAINS • CABLE CHAINS • FLEXIBLE COUPLINGS • STANDARD AND SPECIAL ATTACHMENTS

Chace THERMOSTATIC BIMETAL

Actuates Another Precision Product

THE A T C **american**

MODEL A-7
THERMOSTAT



A Product of American Thermostat Corp. South Cairo, New York

This compact, adjustable thermostat is used by manufacturers of bakers, coffee makers, deep fryers, roasters, solder cups, sealing machines, water heaters and other appliances and industrial and laboratory devices. It is precision assembled for uniformity of calibration range and is so constructed that the bimetal element is not subjected to mechanical stress after disconnection if the thermostat is left "On" at high heat. The heavy-walled rivet eliminates calibration change due to mounting pressure and the silver contacts are welded to stainless steel springs. Other features: trimmer set screw, single screw mounting, rigid control bracket for permanent alignment. The useful range for which units can be supplied calibrated is from 70° to 600° F. Ratings: AC, to 230 v., 1650 w.

"Uniformity" has long been a watchword at Chace because it is uniformity of bimetal performance that saves millions of users of appliances and other temperature-actuated devices from the annoyances and dangers of unpredictable waffles, scorched deep-fat, overheated solder and the like. And the many "uniformities" in Chace Thermostatic Bimetal are the result of over a third of a century of research and development, of advanced processes, of constantly improved precision equipment and of relentless testing and inspection. Add to all this the well-known Chace integrity and you'll know why your name is safe on the outside with Chace bimetal inside.

Remember, Chace bimetal is available in coils, strips and completely fabricated elements of your design. Send now for "Successful Applications of Chace Thermostatic Bimetal" containing many pages of valuable design data.

IT BENDS WITH THE HEAT

W. M. CHACE CO.
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1619 BEARD AVE., DETROIT 9, MICH.

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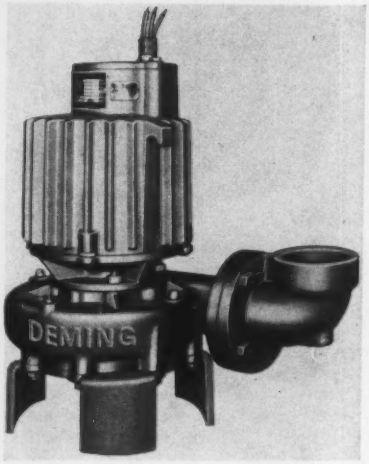

Sewage Pump

A Demersible sewage pump with the motor totally sealed and oil-filled in a cast-iron case has been announced by Deming Co.

Made in capacities from 25 to 800 gpm, it can be quickly installed for temporary service or permanently set for continuous service, with the controls located in any convenient place. It is furnished with 30 ft of waterproof cable.

It has a semiopen-type impeller with a precision bore for perfect alignment, and features a self-cleaning action on the suction-head face. It is keyed for positive drive. Both pump and motor shafts are made of stainless steel.

Bearings are the heavy-duty ball thrust type, self-lubricated and sealed in the motor. There is positive protection against outside moisture and dirt. The base and strainer are made of high-grade cast iron. Float or electrode-type controls are available.

Other Demersible sewage pump equipment includes single pump float switches; dripproof switches; totally enclosed switches, alternator float controls; totally enclosed alternators; high-water alarms, etc.—**K-11**

Plug Valves

New eccentric valves through 6-in. size are available with Viton covered plugs, it is announced by DeZurik Corp. The resilient Viton facing in combination with eccentric action provides a dead tight shut-off on highly corrosive liquids, gases, and slurries.

The physical properties of Viton make it an ideal plug facing material. It does not cold flow; it is highly resilient insuring tight shut off, and it is not damaged by slurry particles. The temperature limits for Viton is higher than most rubber compounds and on some services it can be used to 350°.

—**K-12**

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Dust Filter

The latest addition to the line of dust control equipment manufactured by the Day Co. is an improved "RJ" dust filter which incorporates a simplified method for maintaining the porosity of the filtering media. The filter has also been improved by the addition of a reverse-air-pressure blower, and newly designed air-tight, quick-opening inspection doors.

The "RJ" filter is available in five sizes for light or heavy-grain-loaded airstreams in capacities ranging from 285 to 6400 cfm of air at temperatures up to 300 F. Larger capacities are furnished by multiple groupings. Single units are supplied with round housings, while multiple units are furnished with square or rectangular housings.

The company reports this filter, with its combination of felted filter media and new high-velocity, counterflow air action, permits high filtering rates (air-to-cloth ratios up to 20 to 1) while operating at efficiencies of 99.99 + per cent. —K–13

Gyrol Fluid Drive

A new line of adjustable speed gyrol fluid drives, developed specifically for use with on-the-shaft boiler feed pump drive arrangements, is available from American-Standard Industrial Div.

The firm explains that the units are designed for operation where the boiler feed pump is driven directly from the main turbine generator shaft. Designated Type VS Class 7, the new units are designed to provide a stepless, infinitely adjustable speed control.

The new units are available for use with any size boiler feed pump. Standard units are available for either 3600 rpm or 1800 rpm operating input speed.

Fluid drive shaft height is matched to the centerline height of the main turbine shaft for the simplest possible floor mounting. The unit is designed for below-floor installation of auxiliary cooling equipment and related piping. —K–14

Setting Indicator

Allis-Chalmers has introduced an electromagnetically operated system for externally indicating the close-side setting of gyratory crushes equipped with Hydroset adjustment of the mainshaft and crusher mantle.

The company claims that it is the first time a crusher manufacture has devised any system which will permit the operator to positively determine the setting without entering the machine or employing other time-consuming methods such as dropping lead plumbs.

The indicating system is used in conjunction with the hydraulic adjustment of the mainshaft even while the crusher is in full operation. —K–15

Installation of Aerodyne Units at Consolidated Edison's Hell Gate Electric Generating Station.

72 tons of FLY ASH collected a day!

GREEN'S AERODYNE HELPS SOLVE CONSOLIDATED EDISON'S FLY ASH PROBLEM

Green makes this AERODYNE mechanical dust collector, to collect fly ash and other dusts. Does this Green AERODYNE really work?

Well, let's quote a few words from Mr. J. J. Grob, Chief Performance Engineer, Mechanical Engineering Department, Consolidated Edison Company of New York, Inc.

★ QUOTE 1
Why used • • • • • • • "At Hell Gate Station two Aerodyne mechanical collectors were installed in the uptake flues of boilers No. 11 and 12 for removing the bulk of fly ash leaving the furnaces."

★ QUOTE 2
72 tons of fly ash per day • • • • • • "The furnaces are slag tap and, of that ash which would otherwise be expelled to the electrostatic precipitators before entering the stack, the Aerodyne units, based on careful tests, remove approximately 72 tons of fly ash per day."

★ QUOTE 3
Satisfactory • • • • • • "The operation of the Aerodyne mechanical collectors has been satisfactory and the life of the cones has greatly exceeded expectations."

We repeat, in all modesty—Green can help you solve FLY ASH and DUST collection problems.

Why not write and ask us?

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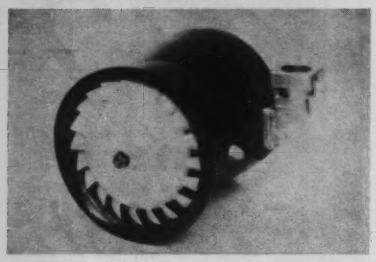

Axial-Flow Blower

General Turbine Corp. has developed a new type of axial-flow blower. Designed like a turbine, it develops extremely high pressures—as high as 25 in. H_2O from 4-india axial-flow rotors. Over 50 per cent size reductions result in many applications.

Large numbers of thin highly curved blades are employed. By reducing the blade height along the air passages, pressure gradients are carefully controlled making possible excellent aerodynamic performance, according to the company.

These units, now qualified by the government for military use, have excellent efficiencies.

Blower drives available are 12-volt dc, 28-volt dc, 110-volt 60-cps and 400 cps.

—K–16

Transparent Adhesive

All types of title blocks, standard parts, wiring diagrams and other printed matter used repeatedly on drawings, maps, can now be quantity printed in advance on Dulseal, the transparent adhesive film from Keuffel & Esser Co.

The film is printed to order or it can also be purchased in blank sheets and rolls. According to the company the material's unique delayed setting action facilitates accurate positioning and allows material to be relocated several hours after original application if necessary. Left untouched for about 24 hr the film's adhesive sets, forming a permanent bond with the paper or cloth to which it is applied.

Made of .0015-in. thick acetate, Dulseal provides a durable protective coating for documents which receive frequent handling. The firm says it is also an excellent mending tape for torn drawings, and is available in narrow rolls. —K–17

Check Valves

Two more models have been added to the Parker Hannifin Corp. line of hydraulic check valves for 3000-psi operation. These are for in-line mounting, with internal-pipe-thread connecting port in one end and Triple-lok machining on the other end for J. I. C. flared-tube connection. —K–18

Micrometer Gage

A micrometer gage claimed to provide an accurate, economical means for locating beveled and rectangular grooves has been developed by the Truarc Retaining Rings Div. of Waldes Kohinoor, Inc. The tool measures the distance from the outer wall of a beveled or rectangular retaining-ring groove to a plane of reference located 0.4 to 1.4-in. from the groove wall.

The gage may also be used for measuring the location of O-ring grooves, rectangular oil grooves, thread reliefs, and other internal recesses in bores and housings and external grooves on shafts and similar parts. The tool will accommodate grooves in housings or shafts 1.5-in. in diam or larger. A special removable flange is included which may be affixed to the spindle to provide an artificial reference shoulder where none exists.—K–19

Filter

An entirely new, fully automatic, high-capacity Vacu-Matic filter for handling water-soluble oil coolants in quantities from 200 to 2500 gpm is now available from the U. S. Hoffman Machinery Corp. In grinding and machining operations the filter makes it possible to obtain higher speeds, faster feeds, and better finishes.

Operation is entirely electrical and continuous without the use of solenoids, air cylinders, or control valves. Paper is indexed automatically making shut-off of dirty coolant through the filter unnecessary. Separation of spent filter paper, sludge, and chips is entirely mechanical. Through the process of aeration, coolant remains constant at ambient room temperature or below. Coolant sweetness precludes the possibility of bacteria growth. Another unusual design feature of the filter is reduction of the size of the service tank. Gravity feed of dirty coolant to filter is possible where plant layouts permit. —K–20

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1 Enemy
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C/E's Nuclear Division also operates the Stationary Low Power Reactor (SL-1), a small boiling water nuclear power plant at the AEC's National Reactor Testing Station near Idaho Falls, Idaho.

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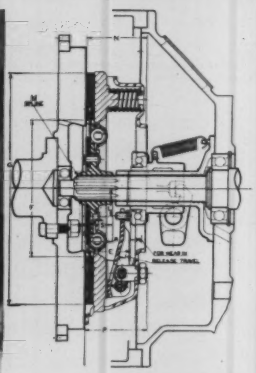

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Make more new customers—more profit—by featuring this NEW "RT" ROCKFORD CLUTCH. More performance—it is increased by smooth engagement of precision parts, no binding, grabbing or friction. More quality—it is increased by the patented features of the rolling fulcrum pin, and the precisely balanced throw-out levers. More work life—it is increased by the reduction of friction heat, precision workmanship and the application of advanced research on the clutch facings.

These improved features make the NEW ROCKFORD "RT" CLUTCH a valuable asset to the prime movers of yesterday, today and tomorrow. The NEW "RT" clutch is now being used in high horsepower commercial vehicles and tractors, where rugged stamina is needed. For more new customers and more profits, specify the NEW ROCKFORD "RT" CLUTCH.

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Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

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CLUTCHES

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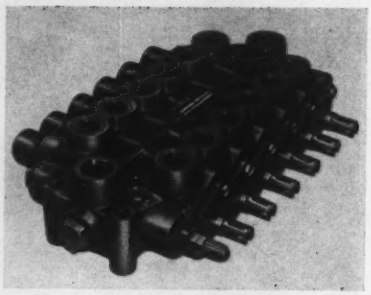

Hydraulic Control Valve

Hydreco Div. of N. Y. Air Brake Co. has released a new hydraulic control valve with parallel internal circuit designed for tractor-mounted backhoes and other heavy duty mobile equipment where rapid sequence of multiple functions is required. The V-33 series valve is available in two, three, four, and six-plunger models, recommended for 20 gpm at 2000 psi. It is a complete fluid power circuit with all required or extra circuit features built into a single compact package.

The valves may be furnished with built-in pilot-operated overload relief valves on individual cylinder circuits as required. These prevent damage from high static pressure that may be developed in a blocked cylinder circuit. Operating plungers may also be provided with built-in swing cushioning valves from boom control or built-in flow control and counterbalance valve. **—K-21**

Regulator Modules

Cutler-Hammer Inc. has available a line of static regulator modules for industrial users.

Trade-marked under the name of "mPAC" modules, the line encompasses ten building block regulators. Originally developed for use on the firm's packaged dc drives and mill processing line control, the regulators are also available to panel builders, control assemblers and custom designers.

Among the modules available are an adjustable time reference unit; power supply; reference regulator; 15-v comparator; 30-v comparator; power amplifier; cross-over unit; adjustable current limit unit; low level current amplifier; and 6-v bias supply.

In addition to the modules, the company also offers a line of magnetic amplifier field supply panels available in five current ratings at either 120 or 240 v dc to provide the power link between the modules and the motor or generator field. **—K-22**

For Consulting Engineers
Turn to Page 216

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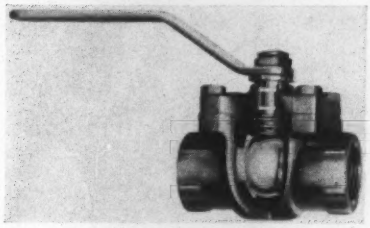

Ball Valves

Hills-McCanna Co. has announced a new line of ball valves designed to reduce initial in-place cost, reduce valve-maintenance cost, and present other positive advantages.

Major products in the new line are the McCannaseal and the McCannaflo ball valves, both of which provide the full flow of a gate valve, the tight shut-off of a globe or needle valve, and the quick quarter turn of the plug valve.

Each product has its own exclusive features. The McCannaseal, for example, offers: (*a*) Two-way flow, (*b*) minimum pressure drop, (*c*) self-adjusting seats, (*d*) back-seated stem seals, (*e*) top entry for easy in-line maintenance, (*f*) no lubricant required, (*g*) noncycling, nontorsional, noncorrosive spring.

The McCannaflo ball valve incorporates: (*a*) A compact design that features shorter end-to-end dimensions and less over-all height, (*b*) positive indication of valve position, (*c*) a back seating stem with double seals, (*d*) interchangeable and pieces for universal assembly, (*e*) interchangeable-seat design.

Temperature ranges up to 350 F, and pressure to 700 psi for the McCannaseal and up to 1000 psi for the McCannaflo. The valves are constructed to handle practically all fluids, semisolids, compressed gases, and compressed air.

Standard body metals include stainless steel, cast steel, ductile iron, cast iron, or bronze. The valve balls are chrome-plated carbon steel, bronze, or stainless steel. Valve sizes range from 1/4 to 6 in. in screwed or flanged-end connections. **—K–23**

Steam Hose

White Line Steam Hose, now available from Titeflex Inc., an Atlas Corp. subsidiary, is the first flexible hose to be specially designed for steam transmission. This new product utilizes an extruded Teflon innercore, pure bronze wire-braid reinforcement and solid brass progressively swaged fittings to counteract the ravages of live steam.**—K–24**

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7 important things for FRICK *and you:*

1. First of all, on a foundation of our 107 years' experience, our new management has established a growth policy that stresses new product development, quality control, and expansion of field services.

2. New branch offices are being opened and the sales-engineering staffs of existing branches as well as of the home office are being increased.

3. A compressor of new design is being developed. This, like our current dependable line, will handle a variety of refrigerants such as Freon, ammonia, propane, butane and carbon dioxide.

4. A new circulating system using refrigerated sea water has been introduced to commercial fishing fleets, at a saving to boat owners.

5. Completely insulated Shell-Ice makers have been "packaged" for convenient field installation.

6. Service to the growing poultry industry has been highlighted by our new counter-flow-continuous poultry chiller, which uses refrigerated water instead of ice.

7. As part of the growth policy, we are increasing the number of Frick distributors. Some of our distributors have been with us 50 years.

All of which indicates one thing: Frick is "on the move!" If you're passing through Waynesboro this summer, stop in and see for yourself; you'll be able to enjoy our remodeled and air conditioned offices.

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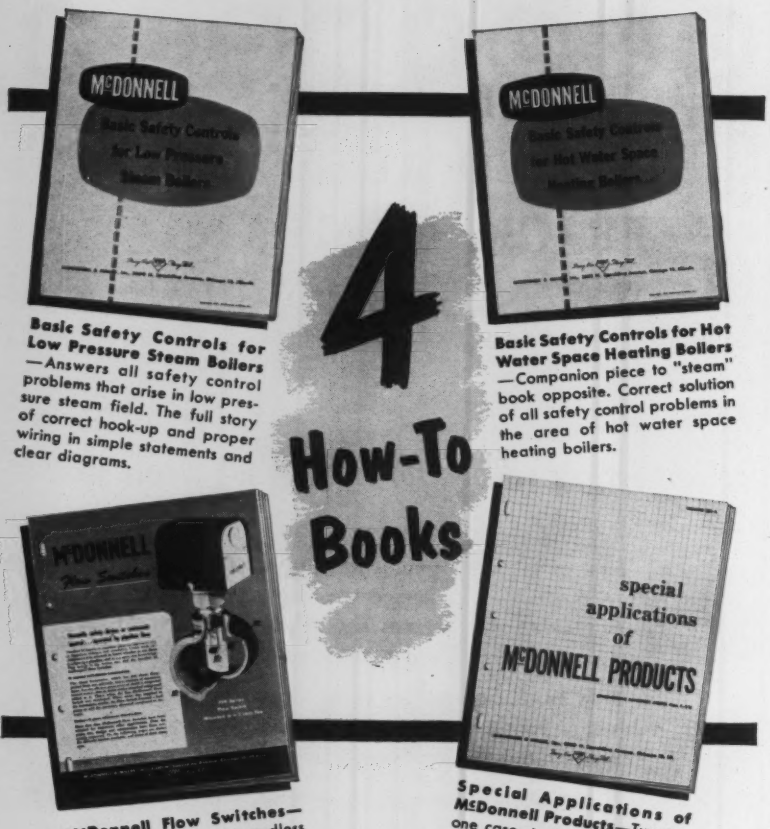
*Pioneers in depend*ability* since 1853: air conditioning, refrigerating; ice making and quick freezing equipment, power farming machinery and portable sawmills.



Basic Safety Controls for Low Pressure Steam Boilers—Answers all safety control problems that arise in low pressure steam field. The full story of correct hook-up and proper wiring in simple statements and clear diagrams.

Basic Safety Controls for Hot Water Space Heating Boilers—Companion piece to "steam" book opposite. Correct solution of all safety control problems in the area of hot water space heating boilers.

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Special Applications of McDonnell Products—Twenty-one case studies of simple control problems that turn up in any plant. Each case suggests others. Liquid level control and flow problems are clearly defined and met.

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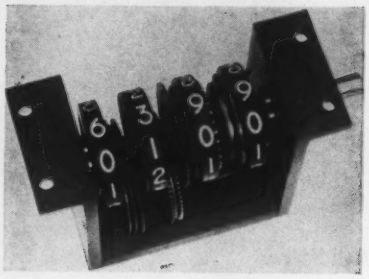

Mil Counter

A mil counter, Model 10519, developed by Bowmar Instrument Corp., is for use in radar indicators, computers, fire-control devices, and missile-tracking devices.

The counter provides continuous and consecutive readings in mils from 0000 to 6399 and return to 0000. Input shaft and units counting drum are direct-coupled, with one revolution providing 10 mils of indication. It combines light weight, 6 oz, small size, $2^{23}/_{32}$-in. long (not including shafts), and large, (0.187-in. high), characters for fast reliable reading.

The unit is designed for continuous operation at 500 rpm and may be operated intermittently at 1280 rpm. The 10519 counter is reversible at any point in its cycle. A left-hand shaft or dual extensions are available on special order.

Designed to meet the requirements of Mil-E-5272A, the counter is corrosion resistant, with black anodized-aluminum housing, and drums. The input shaft is stainless steel, and other parts are hardened, specially treated steel. In special instances, magnesium, titanium, or other materials may be specified. Oilite bearings are standard. Stainless-steel ball bearings are available if required. —K–25

Gear Pumps

A new series of gear pumps for 3000 psi constant pressure and 4500 intermittent pressure service has been announced by Superior Hydraulics Div., Superior Pipe Specialties Co.

The new pumps are designed to deliver uniform flow regardless of variations in fluid viscosity or load and are available with capacities of 5, 10, 15 or 30 gpm. Special pumps with capacities up to 100 gpm are available on order.

According to the company, outstanding, unique engineering features include needle bearings which are contained in a pair of one-piece bearing blocks that will not misalign under loads. This construction assures precision alignment of both gears and needle bearings at all operating pressures, the firm says.

A rear floating bearing block that is urged against the gear faces by hydraulically actuated pistons automatically takes-up wear and maintains zero end clearance. —K–26

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Four-Port Selector Valve

A dual four-port selector valve, Model P2-418, is available from Circle Seal Products Co. Simple 90-deg rotation of the single handle actuates both valve components simultaneously and permits reversal of flow direction of two fluids through two alternate systems. It is intended for use with chromatographic or other gas-analyzer circuits, as well as with precision test systems requiring simultaneous dual-system control.

The valve can be installed between the alternate columns in a chromatographic-analyzer circuit to permit either column to be used while the other is being purged or backflushed. Plugging one port converts it to three-way operation.

The valve is available in either aluminum or 303 stainless steel, and will operate from −40 to +350 F, dependent upon the O-rings specified. It may be used with air, vacuum, carbon dioxide, helium, hydrogen, nitrogen, oxygen, hydrocarbons etc.—**K-27**

Power Rectifiers

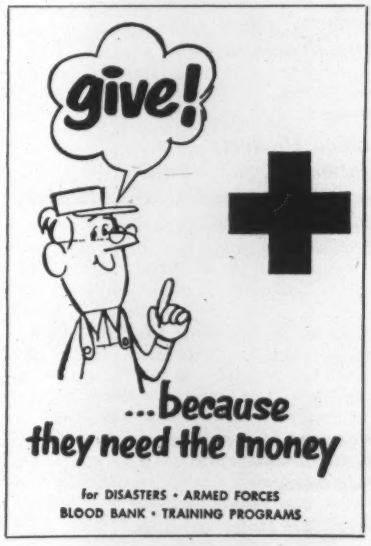
Syntron Co. announces four new silicon power rectifiers.

The Style 10 silicon diode is mounted in an axial-lead top-hat all-welded case. The conservatively rated unit is designed for general-purpose applications up to 1.6 amp.

The Style 11 silicon diode features exceptionally low reverse-leakage currents for special applications. Mechanical configuration and current ratings are identical to Style 10.

Styles 22 and 23 are stud-mounted revisions of the Styles 10 and 11, employing a $^{7}/_{16}$-in. hexagonal base.

Peak inverse voltages range from 100 to 400 v. The single-cycle peak-surge current rating is 20 amp for all diodes. —**K-28**



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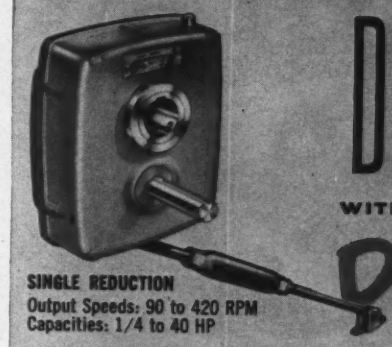
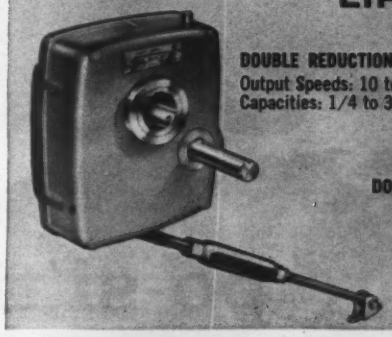
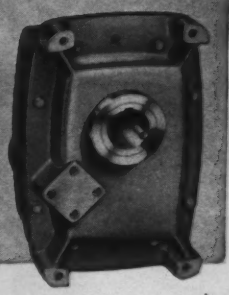
FOOTE BROS. SHAFT MOUNTED DRIVES WITH Duti-Rated® LIFETIME GEARING*



SINGLE REDUCTION
Output Speeds: 90 to 420 RPM
Capacities: 1/4 to 40 HP



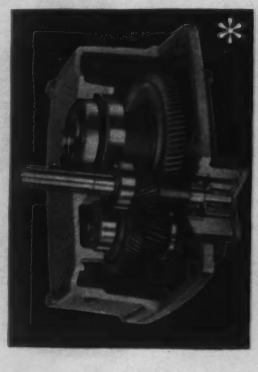
DOUBLE REDUCTION
Output Speeds: 10 to 160 RPM
Capacities: 1/4 to 30 HP



DOUBLE REDUCTION FLANGE MOUNT
Output Speeds: 10 to 135 RPM
Capacities: 1 to 7 HP

Foote Bros. Shaft Mounted Drives offer more efficient, more economical, power transmission. They incorporate exclusive Duti-Rated Lifetime Gearing — the high hardness, balanced design, premium quality gearing that combines greater load carrying capacity with long service life.

Used with standard V-Belts and Sheaves, Foote Bros. Shaft Mounted Drives will provide virtually any output speed you may require. Quick, easy installation on driven shafts with diameters from 15/16" to 3-7/16" saves time, labor . . . eliminates need for reducer mounting, couplings, and adjustable motor mount. Built-in Backstop to prevent reverse rotation, Automatic Overload Release Torque Arm, Variable Pulley, are available as optional equipment.



The complete Foote Bros. Shaft Mounted Drive line is made in accordance with all applicable AGMA Standards

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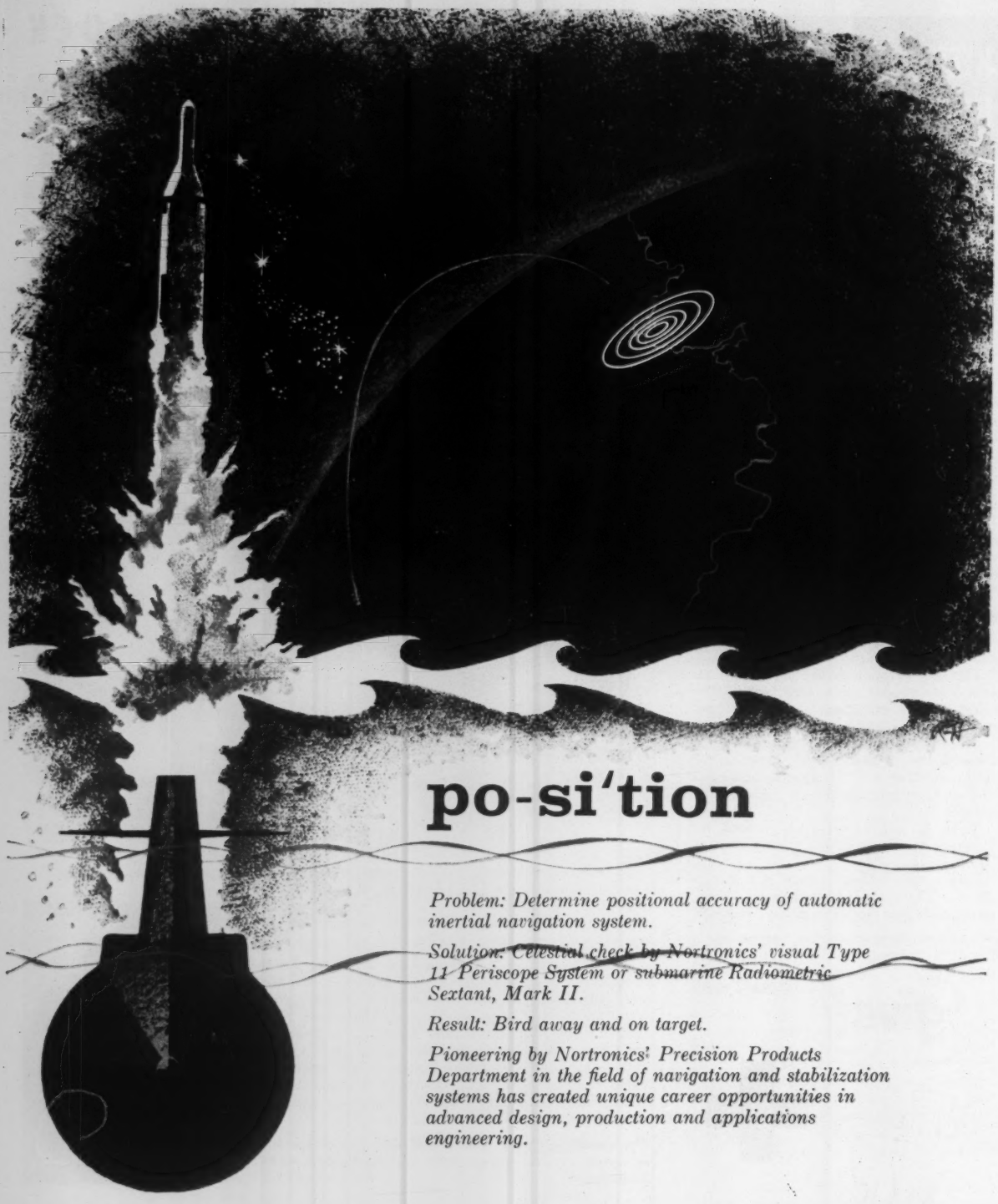

po-si'tion

Problem: Determine positional accuracy of automatic inertial navigation system.

Solution: Celestial check by Nortronics' visual Type 11 Periscope System or submarine Radiometric Sextant, Mark II.

Result: Bird away and on target.

Pioneering by Nortronics' Precision Products Department in the field of navigation and stabilization systems has created unique career opportunities in advanced design, production and applications engineering.

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Thin-Width Instrument Bearings

A new series of thin-width precision instrument bearings designed for use in synchros, gear trains, potentiometers, servos, and small motors is available from Miniature Precision Bearings, Inc. The narrow width of the new bearings saves space, making possible the use of longer stators and rotors in synchros and small motors, increasing power without adding to the over-all length or diameter of the unit.

Made to ABEC class-7 tolerances, thin-width bearings are available without premium charge from the factory and area office stocks in nine sizes from 0.2750 to 0.5000-in. od and bores from 0.0937 to 0.1875-in. with the same exacting specifications as standard company bearings. For this reason the new bearings have the same levels of low torque and the smooth running characteristics of other company bearings. Standard material for balls and rings is 440 C stainless steel. Open, single, and double shielded bearings are included in the series. Details in Bulletin 6002. —K–29

Nonmetallic Gasket Material

Vistex III, a new and improved fiber-reinforced Teflon rubber gasket material, introduced by American Felt Co., has excellent stability to corrosive gases and liquids under both high- and low-temperature conditions. Other properties are 100 per cent compression recovery, exceptional tensile strength, resistance to oil and aromatic fuels, good flexibility, and nonadhesive and noncorrosive properties.

Vistex III is available in sheets up to 30 × 60 in., and in standard $^1/_8$, $^1/_{16}$, $^1/_{32}$, $^3/_{32}$, and $^1/_{64}$ in. thicknesses. It has 84-lb-per-cu-ft density and a minimum tensile strength of 1000 psi. At 300 F, it retains 620 psi tensile strength and at 430 F loses only 105 psi. It is especially well suited for gaskets where light weight is a factor. One square yard of $^1/_{32}$-in. Vistex weighs only 30 oz.

The new material can be precision cut or punched into gaskets, strips, or washers and has excellent chemical stability to acids, alkalis, aliphatic and aromatic compounds. —K–32

Miniature Acceleration Switch

A new miniature, bidirectional, single-axis switch, capable of closing electric circuits in response to a preset acceleration level and resetting itself when the acceleration drops below the preset value, was announced by Instruments Div., W. L. Maxson Corp. Its small size and weight make it particularly suitable for use in aircraft and missile control, measuring, and indicating devices.

The unit consists of a gas damped seismic system with a range of ±10 to ±30g, an accuracy of ±5 per cent, repeatability of ±.5g, a damping ratio of .8 of critical and a temperature range of −65 to +250 F, according to the company. Switch is SPDT, normally open with contact ratings of 100 ma each. Unit is hermetically sealed, weighs 1 oz and has dimensions of $1^{11}/_{16} \times {}^7/_{16}$ in. od. —K–30

Fuel Cut-Out

A boiler safety device announced by Reliance Gauge Column Co., combines float action and electrode-operated functions in a common water chamber. Levalarm EA-100P can be used in several ways—to provide fuel cut-out and low alarm, or dual fuel cut-out, or dual fuel cut-out and low alarm. The float-action operates a sensitive switch, thrown open or closed through the medium of a permanent magnet and special armature. One or two electrodes located at the opposite end of the Levalarm body serve to release fuel cut-out or actuate alarms by means of circuits isolated by small transformer-relay units. The device permits piping economy where two independently operated fuel-cut-out devices are needed. The device is useful on boiler working steam pressures to 350 psi or 650 psi in tank service. —K–33

Instrumentation Valves

Small-line circuitry, including instrumentation, gage cut-off, test panels, and manifolds are listed as applications for a new series of miniature needle valves introduced by Republic Mfg. Co.

Both inline and angle designs are available in brass and stainless steel, either regular, or for panel mounting. Sizes $^1/_8$ and $^1/_4$ in. internal and external pipe, and $^1/_4$ and $^3/_8$ in. od flared and flareless tube threadings are standard.

The firm says the flareless threading can be used satisfactorily with Parker and other flareless type fittings. Temperature ranges from −65 to 450 F. —K–31

Motorized Pry Bar

Western Gear Corp., Industrial Products Div., announces that an enclosed motor unit has been added to its line of Tug-Bar materials handling equipment.

The new unit meets Military Specification B-26974 for use in and around aircraft. It is supplied in three models—1201 for 110 v a-c; 1203 for 200 v 400 cycle; and 1204 for 28 v d-c.

Tug-Bar is a motorized pry bar designed for close quarter load handling where there is insufficient room for a fork lift truck to operate. By using it, one man can handle a two-ton load in confined space, the firm says. —K–34

po-si'tion

A NOTE FOR TALENTED ENGINEERS:
We invite your inquiry as to important positions that exist at Nortronics' Precision Products Department (formerly the Military Products Division of American-Standard).

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Contact E. P. REARDON, *NORTRONICS Precision Products Department, Norwood, Massachusetts*

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a CM Power-Flex Conveyor
using a WINSMITH Speed Reducer

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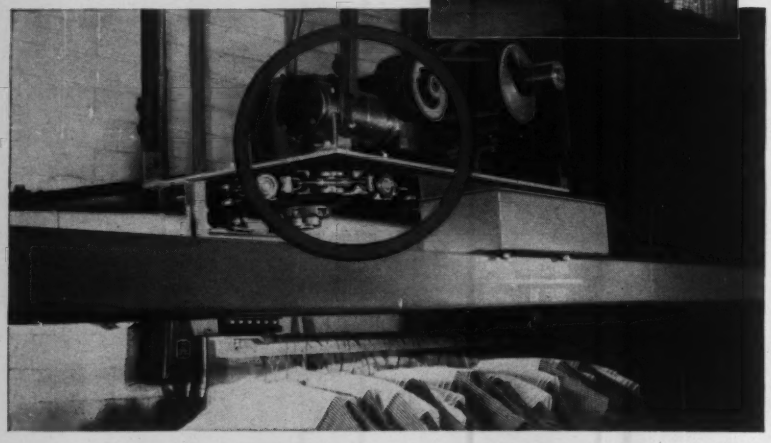
WITH THE POWER-FLEX SYSTEM, Montgomery Ward handles all women's and children's garment requirements for more than 500 retail stores. Each of these trolleys can carry 50 garments or a maximum load of 200 lbs.



A CLOSEUP of the Winsmith Model 5 CVD Speed Reducer used to drive the CM Power-Flex Conveyor which features Telematic Dispatch Control. Chain Speed is 40 ft/min.

MONTGOMERY WARD'S DISTRIBUTION CENTER on Varick Street in New York City, is built around a Columbus McKinnon Power-Flex Conveyor System equipped with a Winsmith Speed Reducer. CM's Power-Flex is a power and free system that, in this application, handles as many as 38,000 women's and children's garments in a single 8-hour day. Its advanced design and construction features permitted savings of 50,000 sq. ft. of floor space and untold dollars in operating economies.

COLUMBUS McKINNON specifies Winsmith Speed Reducers for their Power-Flex Systems because high output efficiency, compactness, long service life, minimum maintenance and low initial cost are prime factors.

FOR EVERY APPLICATION from 1/100 to 85 H.P.—in ratios from 1.1:1 through 50,000:1—investigate the advantages of standardizing on Winsmith Speed Reducers for your products.

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NEW EQUIPMENT
LATEST CATALOGS

Ball Bearings

Two new series of ball bearings—one with inch dimensions, the other with metric dimensions—have been introduced by Hoover Ball and Bearing Co.

Hoover's new R-series bearings facilitate shaft and housing design because all boundary dimensions—bore od and width—are made to convenient inch dimensions.

This series is compactly designed and proportionally similar to conventional extralight and light-series metric bearings. Hoover R-series bearings are offered in 15 sizes for shafts ranging from $1/8$ to $1\,1/2$-in dia.

The newly announced Hoover 30-series ball bearings are designed to fulfill the need for extra-small metric ball bearings for use with shafts and housings of small diameter. Bores range from 4 to 9 mm in dia, smaller than conventional extralight, light, and medium series.

All of these new bearings may be obtained from Hoover either open or shielded. In addition, 30-series bearings may be equipped with a single or double seal. **—K-35**

Canned Pumps

A canned centrifugal pump for the leak-proof handling of volatile, toxic, inflammable, or other hazardous liquids is announced by Goulds Pumps, Inc. The pump is positively leak-proof as it has no mechanical seal, stuffing box, or gland.

Built in two sizes with 1 and $1\,1/4$-in. discharge, the pumps have a capacity range up to 110 gpm, heads up to 100 ft and are recommended for handling clear liquids only. Cooling of the motor and lubrication of all parts is accomplished by circulating a controlled portion of the liquid being handled through the hermetically sealed rotor housing and the grooved bearings. All pumps are equipped with a built-in thermal cut-out device that protects the motor in the event motor-winding temperature exceeds safe limits. Pumps are regularly supplied in 316 (CF8M) stainless steel but other materials can be furnished on application. Data in Bulletin No. 728.1 **—K-36**

Cooling Coils

A new line of cooling coils with greater capacity per unit volume than previous coils, and a simpler, more accurate method of cooling-coil selection are offered by the Trane Co.

A newly developed fin configuration increases heat-transfer efficiency, casings have been redesigned to reduce over-all coil dimensions, eliminate air bypass, and minimize moisture carry-over on the dehumidifying coil; and cast-iron headers have been streamlined. The new coils are available in several models, including standard water coils, cleanable and drainable water coils, and direct-expansion cooling coils. **—K-37**

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K-5	K-16	K-27	K-38	K-49	K-60	K-71	K-82
K-6	K-17	K-28	K-39	K-50	K-61	K-72	K-83
K-7	K-18	K-29	K-40	K-51	K-62	K-73	K-84
K-8	K-19	K-30	K-41	K-52	K-63	K-74	K-85
K-9	K-20	K-31	K-42	K-53	K-64	K-75	K-86
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BUSINESS NOTES
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LATEST CATALOGS

Gear Test Machine

A new variable speed bevel and hypoid gear test machine, designed to test gears up to 36 in. dia in any shaft angle from 10 to 130 deg, has been announced by Gleason Wks.

Besides testing for location of tooth bearing area, the No. 138 hypoid tester can check for quiet operation at any speed from 200 to 2000 rpm, and during acceleration and deceleration, the firm reports.

The gear pair is mounted in the machine with the proper backlash, and run together under a light brake load for a noise test at the various speeds. A marking compound—applied before the test—shows the tooth bearing areas after the gears are stopped. The operator can then place the bearing in the proper position and determine what corrections are necessary on the gear cutting equipment.

The gears can also be run together without backlash. In this slow roll test, the company explains, a light spring tension holds the gears in metal-to-metal contact, and a dial indicator shows the composite error in run-out and tooth spacing.

Design features include an automatic backlash mechanism which establishes the correct lash for each pair regardless of dimensional differences in the gears. —K–38

Controlled-Temperature Cabinet

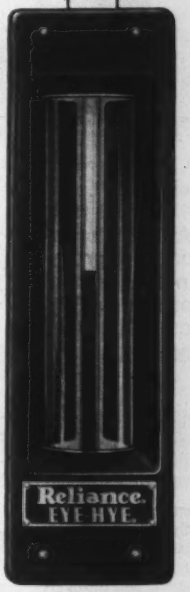
A controlled-temperature cabinet redesigned with several important changes that make it more adaptable to a variety of operating conditions has been announced by W. C. Dillon & Co.

To provide a more uniform temperature, sidewall thickness has been increased, and a positive interlock is employed at all seams or joints. Electric-heating-element surface has been increased so that there is less waiting time for temperature level. An improved thermostat regulates heat to close degree. A larger observation window gives the operator a clear view of the specimen under test.

The Model L tester has a 20-in. daylight opening. Controlled-temperature cabinets will also fit 30 and 40-in. daylight opening models. Specimens are inserted in grips inside of the cabinet in the normal manner and can be checked in tensile, compression, transverse, or shear. The Model L will apply test loads from as low as 0-250 lb up to as high as 0–10,000 lb. It is available either as a hand-operated or motorized unit. Dynamometer gages are offered with 5 or 10-in-dia dials and are readily interchangeable as to capacity. The cabinet can be installed in approximately 4 or 5 min, thus making it a simple matter to check materials at elevated temperatures.[1] Working range is from room temperature to 400 F on the standard cabinet. —K–39

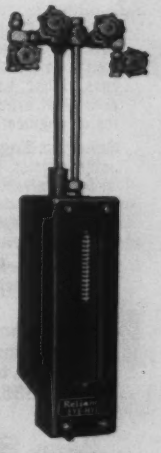
Why a remote reading gage

- Most boiler drums are high — direct gages are far from operating floor.
- Obstructions often make gages hard to see — necessitate special equipment or frequent climbing to inspect.
- Remote gage saves thousands of steps, hours of valuable time. Brings gage reading *down to eye level* at safe distance from boilers.



Why Reliance EYE-HYE

- EYE-HYE assures perfect measurement, dependability and clear reading.
- All-hydrostatic principle — no mechanical parts — no adjustments on location.
- Reads in liquid, like a conventional gage, but easier, faster because of illuminated green indicating fluid.
- Oldest practical remote gage — over 13,000 in use — on land and sea.
- Economical special attachment actuates supplementary alarms, audible or visible, if desired.
- Available for either wall or panel mounting, new wide-visibility EYE-HYEs are made for any pressure range — up to 3000 psi. Also long window model for unusual liquid level variation — for tanks, heaters, etc.



Write for catalog information on EYE-HYE for *your* boiler pressure.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance BOILER SAFETY DEVICES

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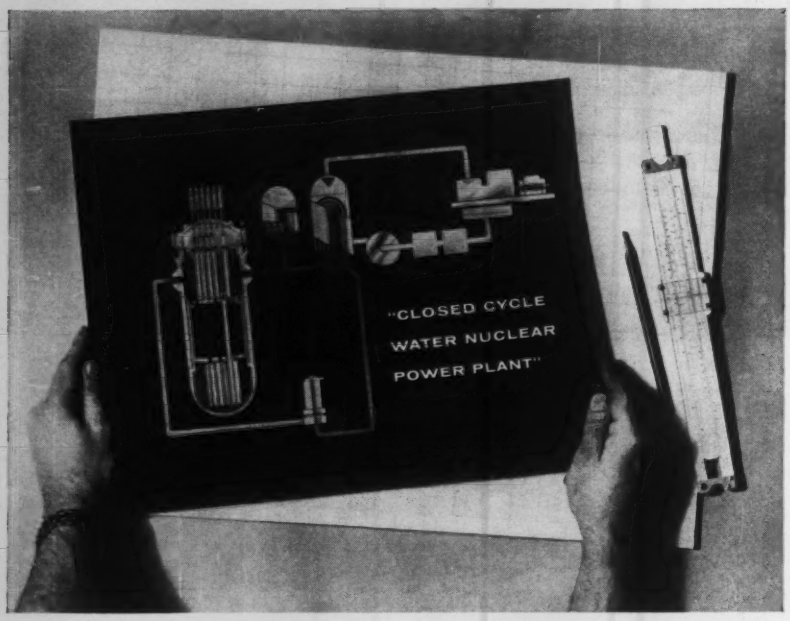

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Scientists and Engineers who want to make the transition to the expanding field of commercial atomic power with a company that is a leader in the field, write to: Mr. C. S. Southard, Westinghouse Atomic Power Division, P.O. Box 355, Dept. W-86, Pittsburgh 30, Pa.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Remote Temperature Control

Transmitter and receiver equipment for remote temperature control has been announced by Powers Regulator Co. Applications of the transmitter-receiver system include both heating-cooling-air-conditioning and industrial processes, especially when remote control is involved.

The Series 200 transmitter transduces a temperature measurement into a 3 to 15-psi air-pressure signal from a remote location. The signal may be sent to a receiver gage which continually indicates the temperature measurement. The transmitter may also serve as a sensor for a remotely located receiver-controller.

Operating in conjunction with the transmitter, the Series 200 receiver-controller can be used at a much greater distance than that of standard thermal systems. The receiver-controller compares the transmitter air signal with its set point, and accurately adjusts its control pressure to maintain the desired control ordered by the transmitter signal. The set point is manually adjusted by an exposed knob. —K-40

Clutch Brake

A miniature clutch-brake combination in which both clutch and brake are magnetically set has been introduced by Stearns Eelctric Corp. When the current is on the clutch magnet and off of the brake magnet, the clutch will operate and vice versa. There is also a neutral position when current is turned off both magnets in the event free wheeling is required.

The unit, designated 2.2 SMCB, available in any d-c voltage up to and including 90 v d-c has a 1.55 curent rating, has 8 lb-in. torque on both clutch and brake side, and comes complete with bearing-mounted drive and driven shafts. —K-41

BUSINESS NOTES

Piping Plant

M. W. Kellogg Co. of New York, a subsidiary of Pullman Inc. will begin construction of a 139,000-sq ft power-piping manufacturing plant in Williamsport, Pa. Completely equipped metallurgical and welding laboratories and the new headquarters of the Power Piping Div. will be included in the $4-million facility.

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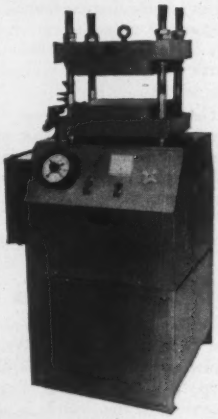

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Power Division Formed

Kearfott Co., Inc., a subsidiary of General Precision Equipment Corp. announces the formation of a Power Equipment Div., engaged in the design and manufacture of rotating and static power supplies, associated control equipment and related power and control apparatus. Equipment will be produced for both military and commercial applications.

Merger

The Texstar Corp. of San Antonio, Tex., and Air Accessories, Inc. have merged. Air Accessories, Inc. will continue operations at Fort Worth, Tex. under the new name Texstar Plastics, Div. of the Texstar Corp. The branch factory operating at Fort Wayne, Ind., will continue under the direction of the Fort Worth based division.

West-Coast Plant

Raybestos-Manhattan, Inc., is erecting a new plant on an 18-acre tract of land recently purchased in Fullerton, Calif. Upon completion within the next few months, the new, air-conditioned plant will replace existing facilities at Paramount, Calif.

It will specialize in the production of R/M Teflon and Kel-F products for the aircraft, missile and rocket, electronic, and chemical industries and provide room for additional expansion.

LATEST CATALOGS

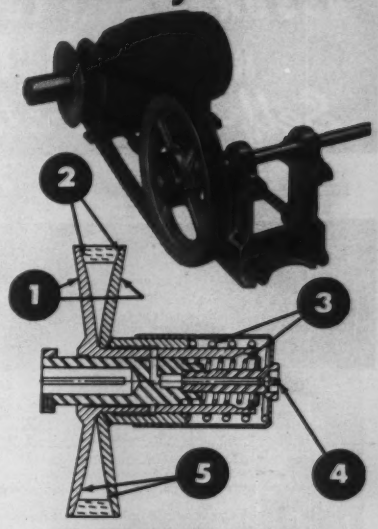
Bronzes

Complete chemical and physical properties of Promet bronzes, a group of alloys made by the American Crucible Products Co. are given in a 16-page brochure issued by the company. The alloys are available as bar stock, replacement parts, or centrifugal castings. Charts are divided into brass and bronze casting alloys, manganese-bronze alloys, and aluminum-bronze alloys.—**K–42**

Stationary Compressors

A 24-page bulletin issued by Joy Mfg. Co. includes specifications on three basic models of the semiradially constructed WN-114 stationary-compressor units ranging from 1385 cfm to 1948 cfm at 125 psi. Package design, components, intercooling, lubrication, motor mountings, and accessories are fully illustrated and explained. —**K–43**

feature by feature...



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5. Curved pulley faces maintain full contact with belt sides at all times, greatly increasing overall efficiency.

Pulleys are available in a complete range of sizes, fractional to 15 hp.—full 3 to 1 ratio. Immediate delivery from stock.

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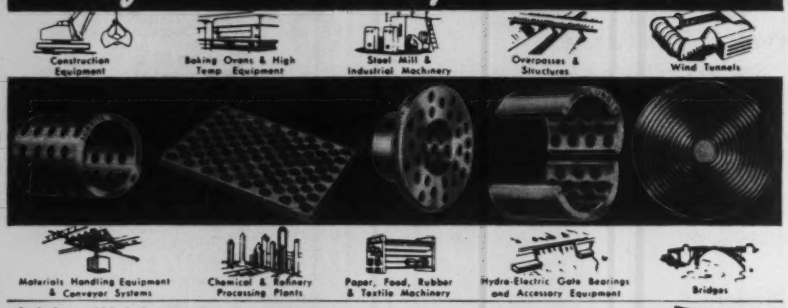
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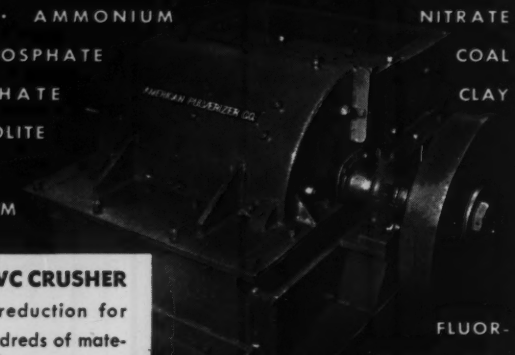

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Rotary Solenoids, Etc.

A new application guide to Ledex rotary solenoids, selectors, and Syncramental stepping motors has been issued by G. H. Leland, Inc.

This eight-page bulletin, No. A-1259, illustrated with line drawings, charts, photographs and circuit diagrams, contains specific physical, performance, and environmental data on more than 250 different models. It also helps to select the proper rotary solenoid, selector, or Syncramental stepping motor for any application.

The highly efficient rotary solenoid is capable of developing twice as much power as ordinary solenoids twice its size.

Its stepping and selector switch—which can be manufactured in hermetically-sealed containers—has replaced the use of numerous ordinary relays in many applications where space and weight present a problem. The switches require only one fifth the space formerly taken up by ordinary relays.

The motor develops at least three times greater torque than comparable devices can provide. During its design life of 2,000,000 steps in each direction, the probability of its missing a step is only 1 in 1,000,000.—K–44

Process-Industry Gages

"Gauges And Instruments for The Process Industries" is the title of a four-page bulletin, No. 3015, issued by the U. S. Gauge Div., American Machine & Metals, Inc. Featured are USG's pressure and vacuum gages (USG Super-gauge and Solfrunt series), indicating pneumatic controllers, and pneumatic transmitters. A schematic shows the installation of a USG indicating pneumatic controller in a typical "cascade" control system.

General "utility" gages, test gages, dial thermometers, pneumatic receivers, recorders, and recorder controllers, drawn-steel-case gages, pressure or temperature alarms and receivers are included. —K–45

Hand Traveling Cranes

A four-page folder, Bulletin DH-468-B, has been issued by the Wright Hoist Div., American Chain & Cable Co., to illustrate Type B-9 top running, single bridge, hand traveling crane which is manufactured in capacities of 1 to 10 tons and in spans up to 50 ft.

The cranes, engineered with a safety factor of 5 to 1, are designed for industrial applications where accurate spotting of loads is more important than fast travel speeds. Features of construction, weights, dimensions, capacities and spans are listed in tabular form. —K–46

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Sintered Metal Parts

A four-page bulletin treating the process of producing sintered metal parts, their physical characteristics, mechanical properties, economies, and applications is offered by Burgess-Norton Mfg. Co. —K–47

Tools

A 48-page catalog issued by L. S. Starrett Co., illustratess and decribes 88 new tools including satin chrome-steel tapes; master vernier height gages and calipers; many micrometer calipers, inside micrometers, micrometer depth gages and micrometer heads; satin-chrome combination sets, protractors, dividers and trammels; Dial-Master indicators and dial bore gages; mechanics' tool chests; and many others. —K–48

Alloy Tube Steel

A folder, released by Tubular Products Div. Babcock & Wilcox Co., discusses two general purpose steels which lend themselves to standardization for alloy tubing.

No. 4340, a through hardening steel, and No. 4620, a case hardening steel are available in tube form in a complete range of sizes. General characteristics and technical data covering these two grades are discussed. —K–49

Fine Wire

A new data sheet, shows the outstanding variety of put-ups now available on fine wire from Riverside-Alloy Metal Div., H. K. Porter Co. The chart presents this data by grouping the various alloys and breaking these groups down into size ranges. This information then refers the reader to the put-ups in which this material is available. —K–50

Hand Torches

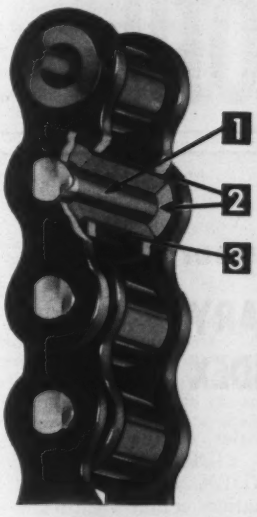
Air Reduction Sales Co. has issued a revised 36-page catalog on its line of gas welding-and-cutting hand torches, outfits, tips and accessories. In addition to general descriptions, features, and specifications for each product as well as aids for the proper selection to fit the intended use.

Many new products and improvements are included. —K–51

Products Bulletin

A 24-page bulletin covers the products of both the Miller Fluid Power and Tru-Seal Divs. of the Flick-Reedy Corp. Designated Bulletin P2547P, it is conveniently sectionalized by products. Air cylinders, hydraulic cylinders, nonsag piston rods, high-speed cushions, adjustable-stroke cylinders, air-hydraulic boosters, air-oil circuits, and Tru-Seal pipe-thread fittings for eliminating positioning problems and leakage at threaded connections are treated. —K–52

WHITNEY MSL* CHAIN solves Another Drive Problem!...



Thousands of owners know the quality engineering of the Imperial Riding Mower manufactured by the Ariens Co., Brillion, Wis., which is backed by over thirty years of engineering and manufacturing experience in rotary tillage equipment. When Ariens engineers originally developed the Imperial, they specified a drive chain that would stand up to abrasive dust and repeated shock loads. They selected Whitney MSL Chain . . . the lubricated-for-life chain that outlasts conventional chain as much as 3 to 1 . . . to assure customer satisfaction.

If you need the *best* chain drive, switching to MSL Chain is no problem, as all essential dimensions conform fully to ASA Standards, making Whitney MSL Chain completely interchangeable with any similar pitch chain.

By developing a chain that incorporates oil-impregnated, sintered steel bushings which give up oil under pressure and heat to lubricate every working part of the chain, Whitney has solved a basic problem: *more damage is caused by faulty chain lubrication than by years of normal service.*

In addition to providing built-in lubrication, inherent characteristics and configuration of Whitney Sintered Steel Bushings provide greater contact area between bushing and links, which permits high interference fit to pre-load links for maximum fatigue resistance.

Why not investigate the many advantages Whitney MSL Chain can bring to your chain drives? MSL Chain is carried in stock by Distributors in all parts of the country for prompt delivery. Write for MSL Chain Catalog.

*Maximum Service Life

WHERE AND HOW BUILT-IN LUBRICATION WORKS

1. Protective oil film lubricates live bearing area between pin and bushing, minimizes wear by reducing metal-to-metal contact.
2. Oil impregnated bushings extend beyond surface of inside plates to: act as lubricated thrust bearings, control clearance, and provide an oil cushion between plates, eliminating plate galling and seizing frequently caused by mis-alignment of sprockets.
3. Oil film on exterior surface of bushings provides constant lubrication between sprocket teeth and chain. No rollers are required, as the tough oil film on bushing surface provides smooth sprocket engagement, cushions impact, and reduces drive wear. When drive stops, bushings re-absorb oil, insuring a permanent oil supply for life of the chain.

THE WHITNEY CHAIN COMPANY
a subsidiary of FOOTE BROS. GEAR AND MACHINE CORPORATION
4559 S. Western Blvd., Chicago 9, Illinois

POWER TRANSMISSION DRIVES

DISCERNING DRAFTSMEN THE WORLD OVER DEMAND IMPERIAL THE WORLD'S FINEST TRACING CLOTH

1806

Mechanical Engineers

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Through the Combined Activities of the ENGINEERING SOCIETIES LIBRARY and the ENGINEERING INDEX engineers have a unique documentation center and coordinated services unmatched elsewhere in the world. Learn how the Founder Societies accomplish the assembling, filing and locating of Engineering Information.

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Marine Hydraulics

A new 12-page brochure on specially designed marine hydraulic components and their commercial and military uses has been issued by Denison Engrg. Div., American Brake Shoe Co.

A section on axial piston pumps specifically designed for marine applications is included. Operating characteristics of pumps and fluid motors for hydraulic service up to 5000 psi are also shown. —K-53

Expansion Joints, Flexible Pipe

A new six-page General Catalog covers the modern line of custom-made rubber expansion joints and flexible pipe produce by General Rubber Corp.

The joints and pipe have given long, trouble-free life in many difficult corrosive and abrasive services.

The new "Gen-Lok" flanged flexible pipe assures perfect bolt-hole alignment in both old and new installations alike. The adjustable cast semisteel retaining rings can move on a full 360-deg circle to line up perfectly with existing rigid-pipe flanges. The multi-ply, wire-reinforced body with flanges extending to the bolt holes acts as their own gaskets under compression. Available in all standard pipe sizes. Tube and cover can be furnished to resist corrosion, oils, heat, and sunlight. —K-54

High-Pressure Equipment

Details and specifications for Hart & Zn high pressure-measuring instruments, compressors, pumps, valves, vessels, gages, and similar equipment are given in a 12-page catalog released by High Pressure Equipment Co.

Valves for pressures to 150,000 psi, multiple dead-weight testers and pressure balances for various pressure ranges, oil and mercury piston gas compressors, high-pressure vessels and temperature-control units for thermostats are included. —K-55

Steam-Turbine Generating Units

A comprehensive bulletin, 03B9448, describing advance design and construction features of large steam-turbine generating units, along with the engineering, development, and manufacturing facilities which make them possible, has been issued by Allis-Chalmers.

Nearly 40 subjects relating to the power-generating units, ranging from compact component design to controls and instrumentation, are covered.

Copiously illustrated the 40-page bulletin includes a table of typical ratings and arrangements of the very large-capability machines available today. —K-56

NO LUBRICATION
NO MAINTENANCE
NO WEARING PARTS

Future maintenance costs and shutdowns are eliminated when you install Thomas Flexible Couplings. These all-metal couplings are open for inspection while running.
They will protect your equipment and extend the life of your machines.
Properly installed and operated within rated conditions, Thomas Flexible Couplings should last a lifetime.

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES:

- Freedom from Backlash
- Torsional Rigidity
- Free End Float
- Smooth Continuous Drive with Constant Rotational Velocity
- Visual Inspection While in Operation
- Original Balance for Life
- No Lubrication
- No Wearing Parts
- No Maintenance

Write for Engineering Catalog

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Jetslingers

A six-page folder, No. 2721, describes the three types of Jetslingers made by Link-Belt Co. Jetslingers are machines equipped with short, high-speed belt conveyers for hurling free-flowing bulk materials into areas inaccessible by other mechanical means. The folder describes and illustrates both the suspended, swiveling, and wheel-mounted units which are used for hurling material into storage in warehouses, boxcars, holds of ships, bins, or upon the ground. Dimensional data are also given.

Jetslingers are available with belt widths of 14, 20, and 28 in. and capacities of up to 700 tons per hr, with materials weighing 50 lb per cu ft. —K-57

Butt-Joint Fittings

A 44-page catalog, No. 3108, containing technical data and descriptions of the complete Hi-Seal butt-joint fitting line is available from the Imperial Brass Mfg. Co.

It contains over 250 additional styles and sizes, and includes first printed material on Braze-Seal Fittings for extra high pressure and temperature.

There are sections on pressure, vacuum, temperature, vibration, corrosion resistance, port seals, flow and velocity characteristics along with laboratory reports and complete assembly instructions. —K-58

Impact Process

A guide and reference for designers, engineers, and purchasing agents called "Alcoa Impacts—Metal in Motion," provides complete information on the latest developments in the impact process—also known as "impact extrusion." Among the advances outlined are greatly increased size ranges, impact containers, and the Alclad impact.

Full potential of the impact process, developed initially by Alcoa 40 years ago, is explored in the 34-page, foil-covered booklet issued by The Aluminum Co. of America. Design possibilities, tolerances, size ranges, and applications of impacts are outlined. —K-59

Sequential Data Logging

A two-page application data sheet, N-07 (1), describing a 100-channel sequential data logging system is available from Leeds & Northrup Co.

It describes the use of this data system to record the test results of components being exposed to nuclear radiation. The operation of this equipment is explained with the aid of a schematic diagram and a description of the system. Complete specifications are listed, including modes of operation, time per channel, visual displays and channel switching. —K-60

CASH-ACME ... meeting pressure control needs for product design engineers everywhere
Type "B" Pressure Reducing and Regulating Valve
CASH-ACME PRESSURE REGULATING VALVE HELPS DEGREASER REACH HARD TO GET AT PLACES

Oil—without which no industry can operate—can also be a liability if allowed to "stick around" too long on newly-machined parts and equipment. That's why industrymen prize their degreasing machinery so highly.

To be effective, the cleansing solvent dispelled by the degreaser must **remove every last particle of oil** from any new product. It's here that Cash-Acme Type "B" Pressure Reducing and Regulating Valve plays such a vital role. Operated by a thermostat, the valve assures the proper pressure and quantity of steam to keep the solvent vaporized. For only in this gaseous state—and under constant pressure—can the solvent reach all these hard-to-get-at places.

TYPE "B" PRESSURE REGULATING VALVE
Ready for highly intricate applications wherever accurate pressure control is vital. Single seated, spring loaded direct operating diaphragm valve. Designed for use with water, steam, air, oil, gasoline, refrigerants, and many other liquids, chemicals and gases. For Answers to Pressure Control Problems in Your Product, contact...

A. W. CASH VALVE MFG. CORP.
666 East Wabash Ave., Decatur, Ill.

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NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

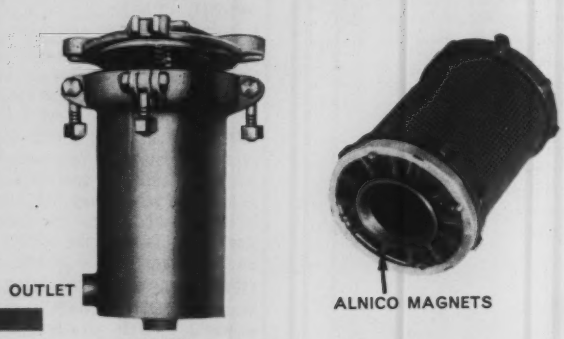
Scale Removal

Dry Lightning developed by Western Chemical Co., is described in a leaflet as a slightly acid powder which can be dissolved in either the hot or cold water that is to be treated. It will remove scale fast without harming equipment. —K–61

Self-Locking Inserts

Complete specifications and application information on Banc-Lok self-locking inserts and tapped holes are presented in an eight-page catalog issued by Boots Corp. Engineers will find easy-to-use charts detailing thread, hole sizes, grip lengths. —K–62

GET THE *ADDED PROTECTION* OF MAGNETIC SEPARATION WITH THIS BASKET-TYPE STRAINER



Nugent now manufactures a line of basket-type strainers offering the added protection of magnetic separation. Specially designed Alnico magnets establish a magnetic field through which the strained liquid must pass as a final stage before leaving the unit. Thus, minute ferrous particles are trapped and removed from the fluid stream.

If you have valuable engines or other equipment which demands top-notch lubrication protection, it will pay you to get the full story on the Nugent combination strainer-magnetic separator.

Write today . . . no obligation, of course.

ESTABLISHED 1897

WM. W. NUGENT & CO., INC.
3412 CLEVELAND STREET, SKOKIE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

Lubrication Systems

A newly revised general brochure, Bulletin No. 26-T, now contains information on the complete line of centralized systems of lubrication offered by Farval Div., Eaton Mfg. Co.

The booklet has been increased to 24 pages to cover new additions to the line. Advantages of centralized lubrication and principles of operation are discussed, as well as system components. Illustrations included.—K–63

Fractional Horsepower Motors

Two-page illustrated bulletin, GEC-1539, lists ratings and frame sizes of open and totally enclosed fractional horsepower d-c motors, was announced by General Electric Co. It describes applications and ordering directions for motors in ratings of $^1/_{30}$ to 1 hp at 3450 to 860 rpm. Features and dimensions of the motors are included. —K–64

New Products

A handy summary technical-data folder available from the Carborundum Co. Some of the new materials are available in full commercial quantities; some are in pilot-plant stages; and others are available in sample quantities for experimental purposes. These products represent significant advances in materials resistant to abrasion, chemicals, corrosion, nuclear radiation, and high temperatures. —K–65

Self-Locking Nuts

A 32-page design manual, No. 5930, issued by Elastic Stopnut Corp., illustrates the ESNA developed Equa-Stress modified UNF-3 thread form. Installed in a new series of Elastic Stop nuts, it is claimed that it will at least double the fatigue endurance of a standard high-tensile bolt.

The manual includes 17 pages of findings on the basic nature and causes of fastener fatigue; details of the new Double-Durability self-locking nuts; and applicable fatigue-performance test results. Photoelastic comparisons are made between standard and improved nuts. —K–66

Packaged Boilers

A four-page bulletin, Form No. 1145, describing Kewanee forced draft square-heat packaged boiler-burner units for oil, gas, or combination firing is available from American-Standard Industrial Div. The bulletin contains ratings, dimensions, and technical data in easy-to-read tables. Also included are a typical specification and a list of standard factory-mounted accessories. —K–67

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Chemical-Processing Equipment

A 12-page brochure, S.A1133, describes equipment, processes, and services for the chemical processing industry made by De Laval Separator Co.

Centrifuges, plate heat exchangers, screens, and laboratory devices are included.

Two processes—production of crude tall oil and refining vegetable oils—are described and soap production, starch manufacture, and animal fat rendering are also discussed. —K-68

Colorful Scale Broadside

The full line of scales for industrial use is presented in a new multi-colored broadside, Form 2001e, recently released by Toledo Scale Corp. It illustrates and describes the wide selection of the company's weighing equipment including portable, bench, floor, built-in motor truck, counting, net weight packing, mail and parcel post scales, and also custom-built types.

The broadside has seven accordian folds which expand to an overall size of 26¼ x 9 in. Pertinent specifications and capacities are listed for each model. —K-69

Aluminum Joining

"Fusion Welding Aluminum," is the latest addition to Reynolds Metals Co. series of technical handbooks on aluminum joining methods.

The 32-page booklet covers gas welding, metal arc welding, TIG (Tungsten, Inert-gas) welding, straight polarity TIG, MIG (Metal, Inert-Gas) welding, TIG-welded joint design, and MIG-welded joint design.

Other Reynolds technical handbooks on joining include "Adhesive Bonding of Aluminum," "Riveting Aluminum," "Mechanical Joining of Aluminum," "Soldering Aluminum," "Brazing Aluminum" and "Screw Fastening of Aluminum." —K-70

Flexible-Shaft Assemblies

Over 180 variations of flexible-shaft assemblies may be ordered directly from a standard flexible shaft catalog now being offered by F. W. Stewart Corp. These Circle Ess standard assemblies will provide the same advantages offered by use of a special flexible-shaft assembly plus many additional advantages.

They are assembled from stock components, reduce cost and time-consuming engineering consultation, and greatly reduce the time required for delivery. —K-71

Copying Machine

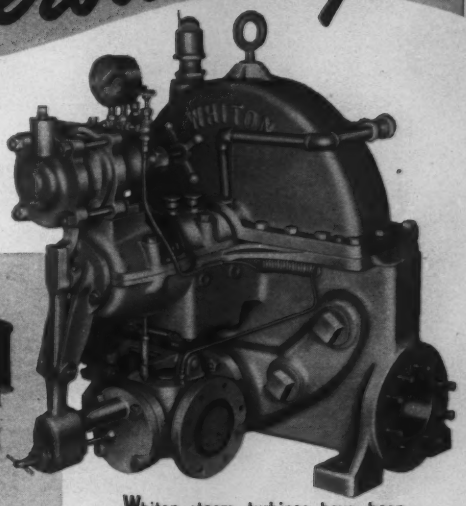
A. B. Dick Co. has issued a six-page folder illustrating the features of the Model 110 Photocopier, and outlining simple, step-by-step operating procedures. —K-72

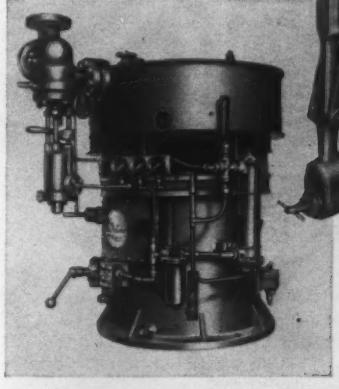
Wire Rope

A condensed catalog listing of up-to-date weights and strengths of both improved plow steel (Monarch Whyte Strand) and extra improved plow steel (PREmium Whyte Strand) have been released by Macwhyte Wire Rope Co. Bulletin No. 6025. —K-73

Whiton COMPLETE TURBINE Versatility

- both horizontal and vertical designs
- from fractional to 1200 HP
- for industrial and marine applications





Whiton steam turbines have been faithfully serving industry for more than 50 years. During this time, a versatile line of quality turbines has been developed to efficiently drive pumps of all types, blowers, air compressors, generators, fans, stokers, and other process equipment.

Equipped with such features as constant speed governor, separate overspeed emergency stop and dynamically balanced rotor, speeds are obtainable to 8500 RPM suitable for steam pressures to 1250 psig and temperatures to 1050° FTT.

For complete specifications, contact The Whiton Machine Company or the Whiton representative nearest to you.

Whiton SINCE 1856

THE WHITON MACHINE COMPANY
NEW LONDON, CONNECTICUT

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Submersible Pumps

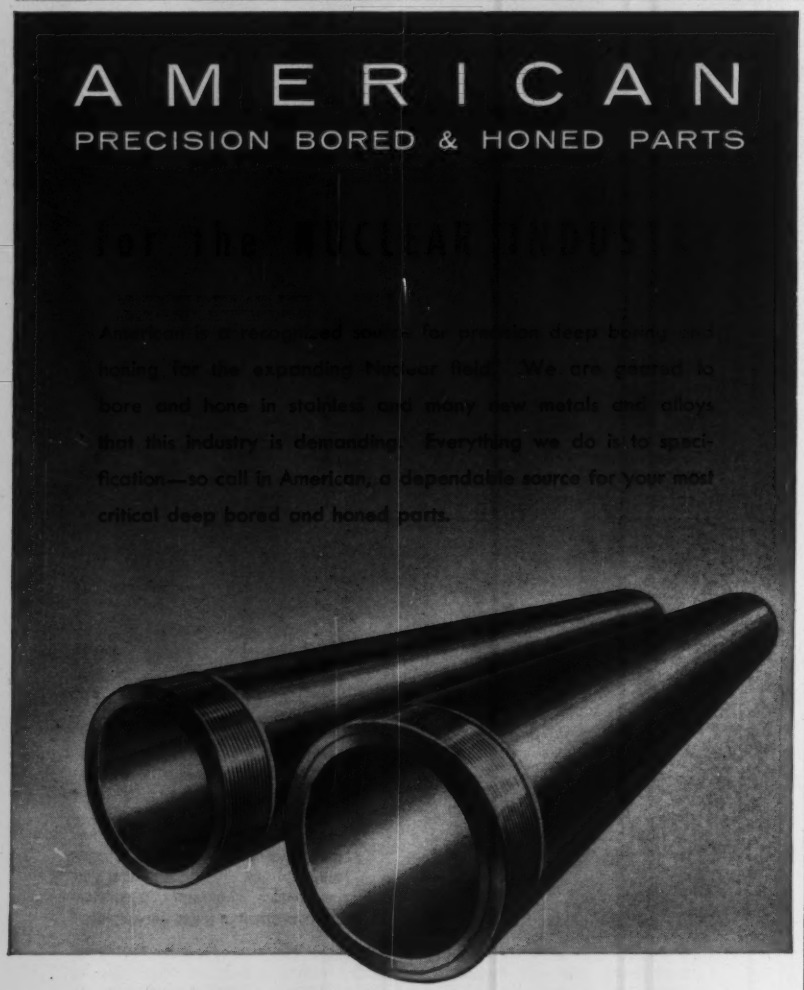
A four-page folder issued by Sier-Bath Gear & Pump Co. outlines many cost-saving advantages of submersible rotary pumps in storage-tank service; describes several typical installations; types, capacities, and construction of rotary pumps detailed. —K–74

Glass High-Vacuum Systems

Standard and custom-built glass high-vacuum systems and many accessory items are described in a catalog issued by Delmar Scientific Laboratories. There is also detailed information on installation and application. —K–75

AMERICAN

PRECISION BORED & HONED PARTS



A new 20 page brochure describes our services. Write for a copy.

AMERICAN HOLLOW BORING CO.

You can depend on American as a reliable source for precision bored and honed parts for your most exacting applications.

1058 West 20th Street • ERIE, PENNA.

Belt Drives

"Wood's Ultra-V Drives," a 36-page bulletin, No. 1902, issued by T. B. Wood's Son's Co., has information on a drive said by the manufacturer to reduce over-all drive dimensions by as much as 50 per cent, save up to 25 per cent in weight, and up to 30 per cent in cost over conventional V-belt drives. Drive-selection tables for stock and nonstock sheaves, horsepower tables, nomograms for service-level comparisons of drive costs, sheave and belt specifications, bushing and keyseat specifications, installation instructions for "Sure-Grip" sheaves, and information on how to check the tension of an Ultra-V drive are included. —K–76

Saw Blades

Ladish Co. published a new 36-page saw blade handbook, Bulletin 578, presenting guides for getting maximum cutting performance and blade life. Shows how to select proper blade, correct feed, speed, and tension. Common cutting problems and their solution are tabulated along with recommendations for cutting a wide variety of metals and nonmetals. Sizes and types of blades in the company's complete blade line are tabulated for quick reference. —K–77

Permanent-Magnet Pulleys

A new bulletin furnishes useful data and specifications on Stearns Magnetic Products complete line of pulleys, ranging from 12 to 48 in. in diam. It explains how Indox V, a highly oriented barium-ferrite ceramic magnet material provides pulley performance equal to the most powerful electromagnetic types at much lower cost. An easy-to-use selection chart is included. —K–78

Electronic Products

A comprehensive 24-page electronic products catalog, Bulletin AD-169, has been issued by Garlock Electronic Products, The Garlock Packing Co. The bulletin outlines Chemelec Teflon, Nylon, Kel-F, Delrin, and other plastic electronic components currently being manufactured by the company.

Specific mechanical and electrical design and environmental characteristics are outlined. Comprehensive drawings, illustrations, and tables are furnished for such items as metal-base stand-off and feed-through insulators, hermetically sealed feed-through insulators, compression mounted and miniature nine-pin tube-base connectors, test points, a wide variety of miniature and sub-miniature sockets, copper-clad Teflon for printed circuits, spaghetti tubing, and grommets. Also several basic engineering drawings of Chemelec stand-off and feed-through insulators. —K–79

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Corrosion Resistant Alloys

A bulletin on tubing and pipe made of Hastelloy Alloys B and C has been issued by Carpenter Steel Co., Alloy Tube Div.

The bulletin outlines applications of these super corrosion resistant alloys and describes their resistance to corrosive fluids. Tables show the comparative resistance to various corrosive media such as hydrochloric, phosphoric, and sulphuric acids, nitric and oxidizing acid mixtures, organic acids, chlorine and hypochlorites, and acid salts at specified concentrations and temperatures. Other tables show the chemical analysis and physical and mechanical properties. —K–80

Feedwater Heaters

A 16-page bulletin, YHT 102, issued by Yuba Consolidated Industries, Inc., presents construction details and operating features of Yuba feedwater heaters as well as several installation pictures.

The bulletin describes many of the design and construction innovations introduced by Yuba—Multilok closure, copper-alloy tubes welded into steel tube sheets, all-welded shell, and the first all-welded heater—to meet the exacting requirements of supercritical pressures and temperatures for steam-electric generation. —K–81

Fasteners

A 24-page catalog describes the complete line of Huck Mfg. Co. fasteners. It includes discussion of a broad variety of tension and featherweight Huckbolt fasteners, self-broaching Huckbolt fasteners, self-sizing Huckbolt fasteners, pull-thru blind rivets, friction-lock self-plugging blind rivets, and lock-spindle self-plugging blind rivets.

Driving cycles, strength data, typical applications, grip ranges, significant dimensional data, hole-size recommendations and installation notes are included for each fastener, as well as installation tools and company services. —K–82

Vacuum Filters

Two vacuum filter styles for the efficient filtration of industrial process water where a highly polished water is required are featured in a new bulletin, No. 1860.20-2, issued by Proportioneers Div., B-I-F- Industries, Inc.

The filters, Model VFL with flat leaf filter elements, and Model VFC with concentric leaf filter elements, are designed for filtering atomic energy cooling water, photographic laboratory water, for filtration ahead of deionizers. Both filters are made entirely of heavy-duty, corrosion-resistant materials, including the filter shell, inner elements and baffles. Both feature open-tank construction for visible operation, and top-take-off. —K–83

Torque-Arm Reducers

Modern methods of speed reduction with compact, shaft-mounted units in a wide range of sizes and horsepowers are described in a 64-page bulletin, A692 issued by Dodge Mfg. Corp.

The Dodge torque-arm reducer line now includes reducers built for capacities up to 170 hp—with output speeds from 10 to 400 rpm— in single and double-reduction series, with 5 to 1, 15 to 1, and 25 to 1 ratios. —K–84

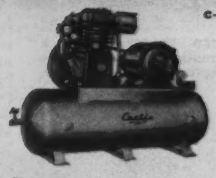
POWERING

with Curtis compressors

DEPENDABILITY
DICTATES USE IN VITAL APPLICATION
New facility acts as high speed communications headquarters for metropolitan fire and disaster control.
Architects:
Hellmuth, Obata & Kassabaum
Consulting Engineer:
John O. Falvey
NEW FIRE ALARM CENTER IN ST. LOUIS SELECTS CURTIS EQUIPMENT "TO RING THE BELL"

C-127

Curtis air compressors were selected for two different jobs in this just-completed "nerve center." By pressurizing cables that contain 1,172 miles of underground telephone and telegraph circuits, communications are protected against water or other damage. Another Curtis compressor powers eight cleaning jets located at key points inside the Center.



Full line of compressors available 1/4 to 50 H.P.

In application after application, high-dependability Curtis compressors are confidently specified for best results. They're competitively priced, too. All tanks meet ASME specifications: units have Curtis-Seal Crankcase, Adjustable Timken Tapered Roller Main Bearings, Self Centro-Ring Oiling, Air Cooling (no cooling water required). Write for Free Catalogs covering the complete Curtis line.

THE COMPLETE LINE OF HORIZONTAL AND VERTICAL COMPRESSORS • AIR CYLINDERS • PENDANT AIR HOISTS

Curtis MANUFACTURING COMPANY

PNEUMATIC DIVISION • DEPT. 44, ST. LOUIS 33, Mo. • Established in 1854

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Radial Drill Press

The Radial Drill Press, a new drilling tool that can drill to the center or at any point on a 32-in. square, is described in a two-color, photo-illustrated bulletin AD-1222, issued by Rockwell Mfg. Co., Delta Power Tool Div.

Large capacity, adaptability to all types of drilling and versatility are the major advantages of the new tool. It can also do sanding, shaping, routing, and many other operations. The unit comes in four speeds, 700, 1250, 2400, and 4700 rpm for drilling a variety of materials. **—K–85**

Condensate Drainage

Cochrane Corp., has prepared a paper, Reprint 126, on the solution of the problem of obtaining maximum and efficient latent heat transfer from steam to a product which will be of interest to all operators of steam process plants utilizing revolving drum dryers, jacketed equipment, submerged coils, air heating coils, platen and stationary presses, etc. **—K–86**

Fire-Resistant Ceramic Fiber

Fiberfrax ceramic fiber that withstands operating temperatures up to 2300 F is treated in an eight-page multicolored brochure published by Carborundum Co. It gives the properties, available forms, and current uses of this versatile high temperature material.

Typical uses discussed include linings for domestic oil burners, linings for induction furnaces, brazing metallic honeycomb sandwich panels in airframe industry, general furnace insulation, and critical applications in missile and space vehicle programs. **—K–87**

Vibration Pickup

The Type 4-120 vibration pickup manufactured by Transducer Div., Consolidated Electrodynamics Corp. is described in an illustrated two-color bulletin.

Set forth in Bulletin 1575 are a general description, specifications, applications, and a nomograph of this precision calibration standard. **—K–88**

Antiscale

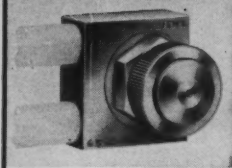
A leaflet is available from Western Chemical Co., describing three antiscale protective treatments.

Westo potable-water treatment, available in either liquid or powder form, is composed of polyphosphate and silicate compounds. These are suitable for treating the water supply of a building, institution, or plant without interfering with the basic standards for drinking, bathing, and cooking. The company claims that the chemicals prevent the rusty water, corrosive attack on metal surfaces, and scale deposition which create problems in heating, storage, and transport.

Sweet water—fresh water (as distinguished from brine) that has been chilled to within a few degrees of freezing and is used as a coolant, particularly in milk-processing plants and creameries—is another Western Chemical.

Westo brine treatment is a group of special formulas individually tailored to provide the necessary alkalinizing and inhibiting agents for the type and condition of brine to be treated. **—K–89**

SPRAY NOZZLES ...THAT FIT INSTALLATION NEEDS



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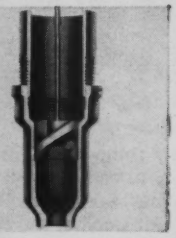

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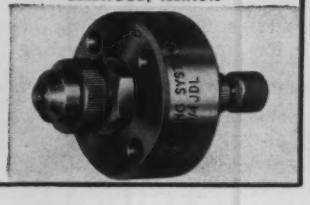

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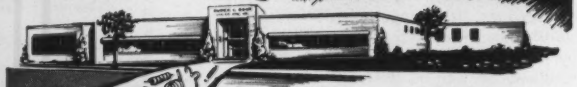

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It is the valve in which the stem is precision machined and ground. Perfect stem alignment and fine threads provide easy and precise throttling. Special "Marpak" packing always holds tight; never binds.

Bodies of the 1900 series identified by the yellow handle are machined from high grade carbon steel bar stock marked in accordance with M.S.S. regulations showing size, material and service. Stems are 416 stainless steel. Valves are available in the patterns shown below; sizes ⅛", ¼", ⅜", ½", ¾" and 1".

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In conventional valve (left) stem-guide is threaded into body . . . can be backed out when valve is fully opened, causing real trouble when pressure is high. Can't happen with Marsh design (right). Marsh stem-guide is welded to body.

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Section 3 of the Code for Pressure Piping

These 1959 rules replace those for petroleum refinery piping in the 1955 Code for Pressure Piping. The code covers all piping within the property limits of a petroleum refinery, loading terminal, gas processing plant, bulk plant, compounding plant, or refinery tank farm, as well as the interconnecting lines between separate sections of a refinery. It applies to piping systems handling all fluids and to most all types of services, including oil, gas, steam, air, water, chemicals, and refrigerants.

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This 1959 document supersedes the section of the 1955 Code for Pressure Piping pertaining to oil transportation piping systems. Included within its scope are all piping carrying crude oil, petroleum products, and liquified petroleum gas between producers' lease tanks, terminals, refineries, natural gas plants, other delivery and receiving points; also liquified petroleum gas storage facilities of the closed pipe type, fabricated from pipe and fittings, and the lines interconnecting these facilities.

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In each of these 1959 Standards will be found the requirements for the design of component parts and assembled units, including the necessary pipe supporting elements; evaluation and limitation of stresses, reactions and movements associated with pressure, temperature and external forces; fabrication, assembly and erection of piping systems; testing and inspection of elements before assembly or erection, and the completed system after erection. Material specifications and component standards are listed.

GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS—1958 Edition

Section 8 of the Code for Pressure Piping

In this 1958 code are the rules for the design, fabrication, installation, testing, and the safety aspects of operation and maintenance of gas transmission and distribution facilities, including gas pipe lines, gas compressor stations, gas metering and regulating stations, gas mains, and gas service up to the outlet of the customers' meter set assembly; gas storage equipment of the closed pipe type; gas storage lines; and the conditions of the use of the elements of piping systems. Dimensional standards and material specifications are designated.

Changes incorporated in this 1958 standard enable the user to interpret code provisions more easily, reduce excessive number of flattening tests required for electric-resistance-welded pipe, eliminate ambiguous and arbitrary requirements concerned with use of electrical equipment and wiring, bring into agreement with other standards an acceptable welding end treatment for butt-welded connections—eliminating necessity of transition pieces, define levels at which odorization of gas is required, require companies to have a plan for sealing off supply of gas to all abandoned distribution facilities as well as to abandoned mains and services, and bring up to date the list of specifications referred to in the standard.

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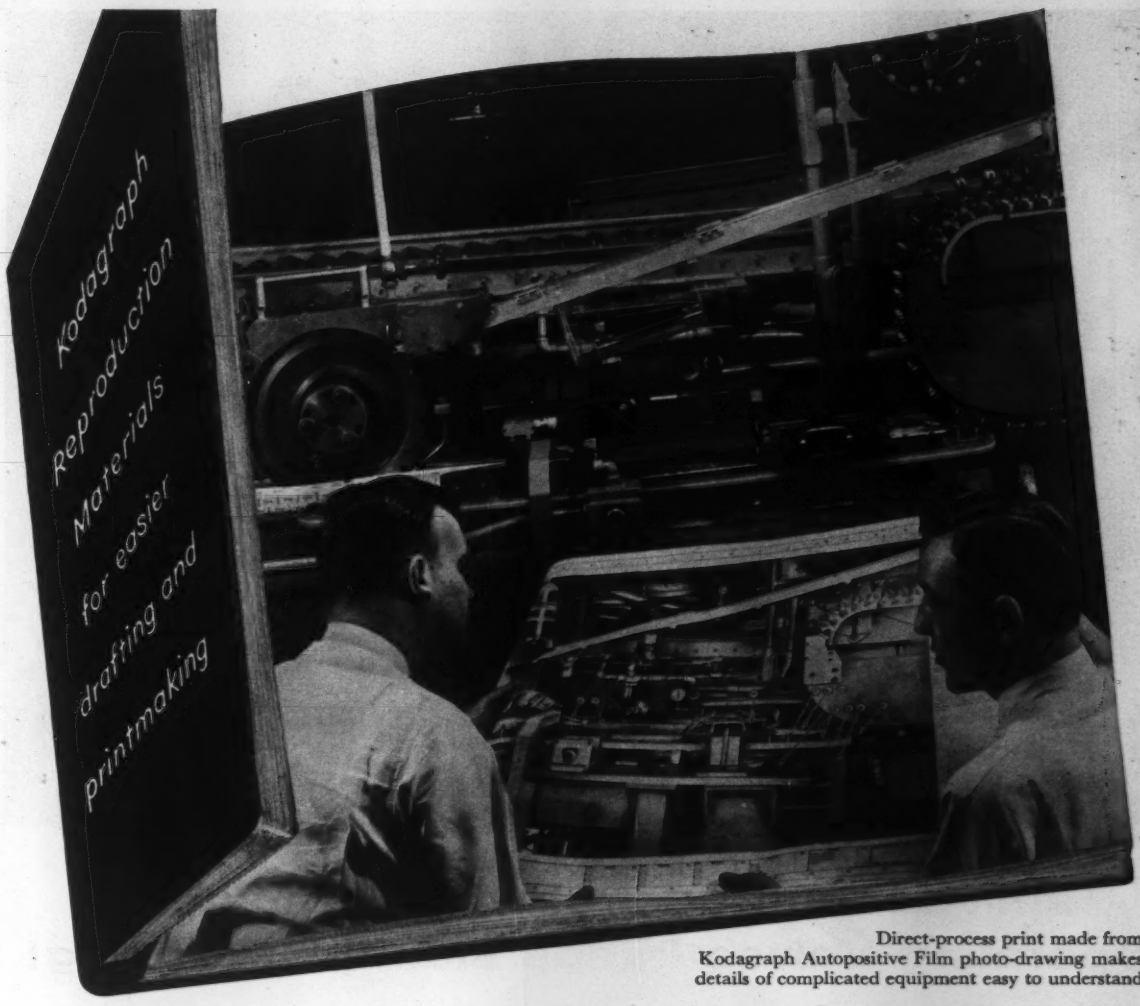

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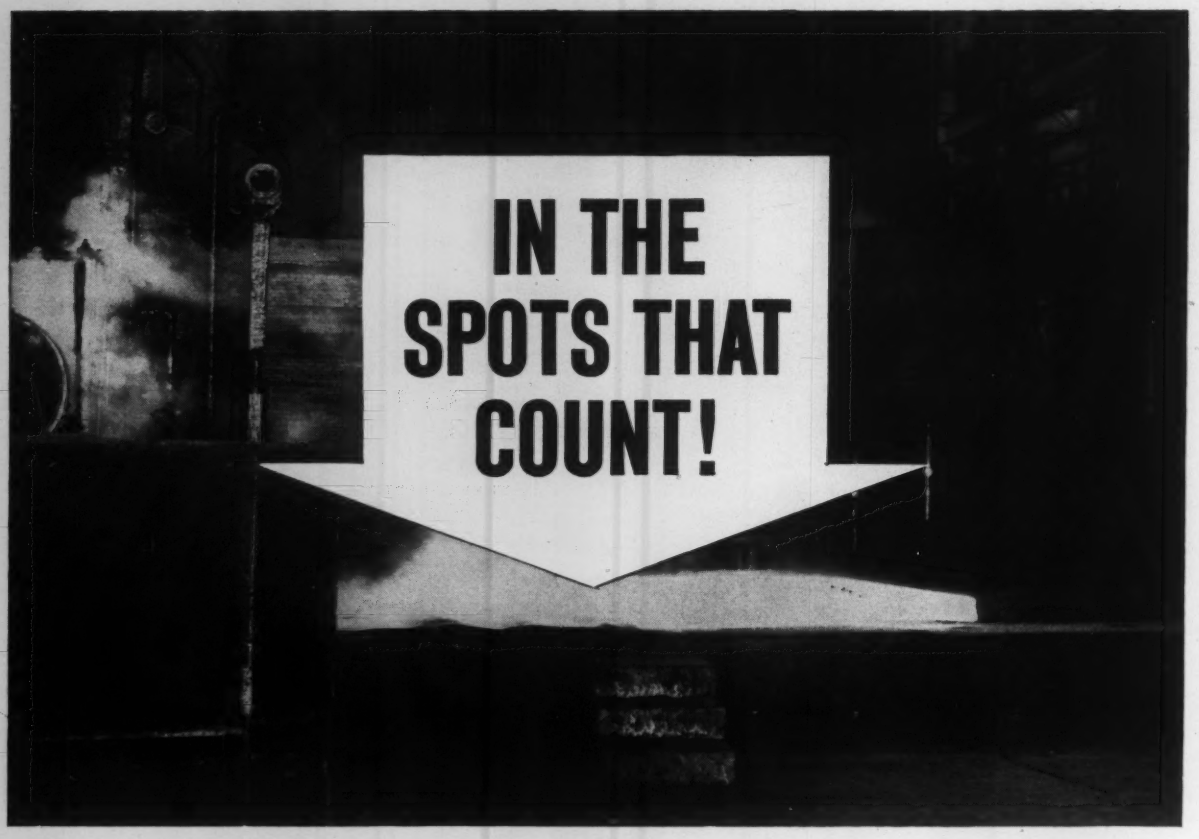

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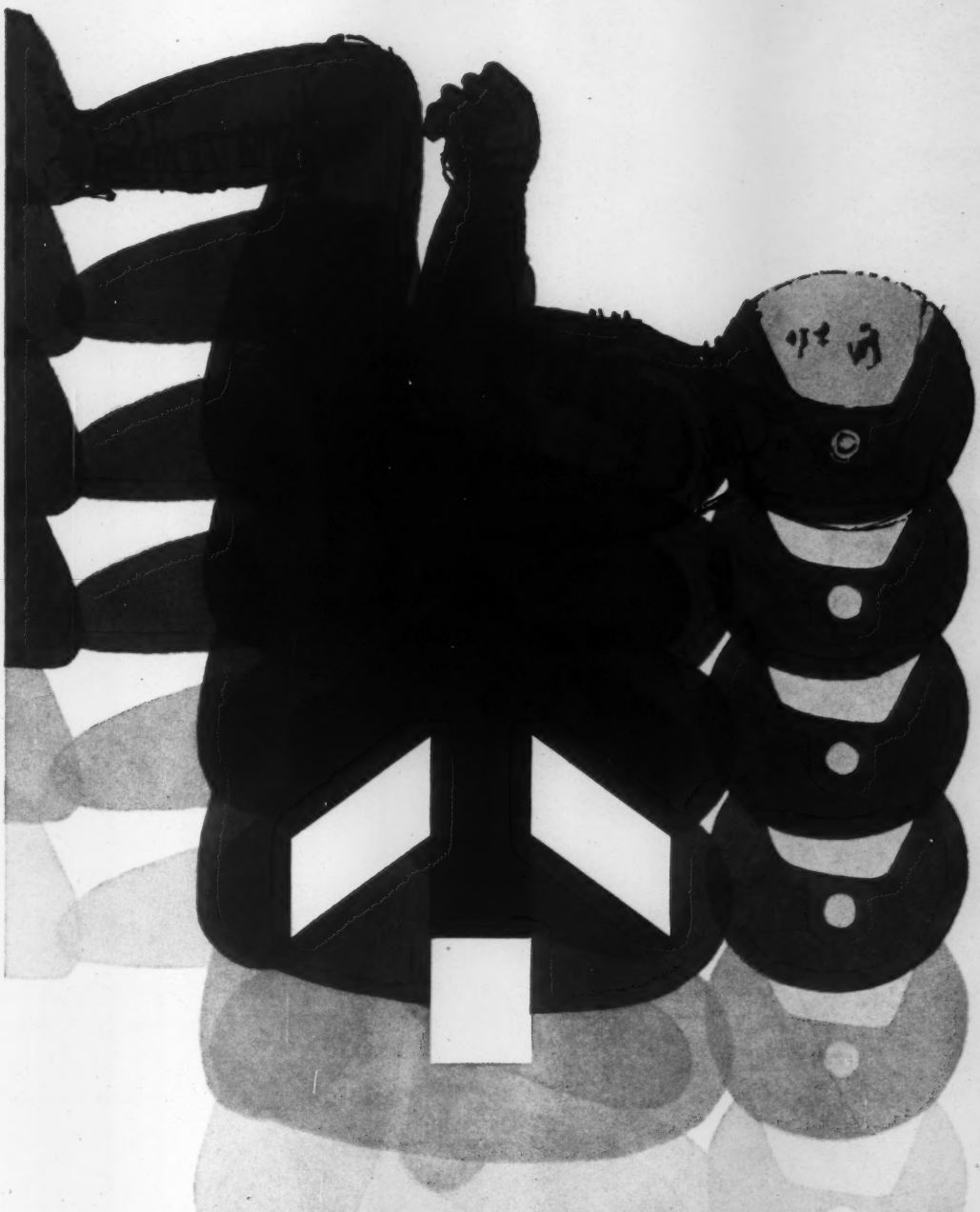

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Expansion Joint Design Moves out of the "Model T" Era

Badger first began fabricating packless metal bellows expansion joints more than 35 years ago. These "Model T" joints performed (and are still performing) with outstanding success in hundreds of process and steam line piping installations.

Starting in the 30's other expansion joint manufacturers entered the field. The most successful adopted many of the basic features of the original Badger design.

During the last decade, as industry's requirements became more stringent, and joint manufacturers gained fabricating and field experience, certain fundamental problems inherent in the early designs became evident. Most of these problems were solved through a series of modifications. (Among which was the Badger Directed Flexing Self-Equalizing Joint — the famous "DFSE" Design.) But, at best, the modifications were stop-gap measures which complicated the joints and greatly increased their weight. A fundamental reassessment of expansion joint engineering data was needed. Badger led the way: In 1956, a task force completed a three-year research program and the first S-R (Service-Rated) Expansion Joints were produced.

In the three years they have been available, S-R Expansion Joints have been both an engineering and a sales success. But like many revolutionary concepts which upset tradition, the full implication of the advantages S-R Joints offer is still not universally understood. The message that follows is an attempt "to set the record straight."

• • • • •

Equalization — fact and fiction

Many users of expansion joints are under the impression that the so-called "equalizing" rings on today's conventional type expansion joints distribute movement equally among all the corrugations of the bellows. It is argued that as the joint absorbs thermal movement, the tops of the rings progressively come into contact until the bellows is fully compressed thus limiting the amount of compression which any one corrugation can ultimately absorb (see diagram 1). In *this* sense the rings do contribute to the "equalization" of movement by physically limiting the compression of each corrugation to the distance between any two adjacent rings.

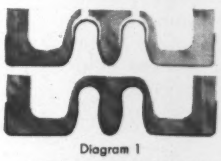

Diagram 1

Conventional Type Expansion Joint. Cross-sections of rings and bellows of a conventional "self-equalizing" joint showing cold and hot positions. Note that true equalization of movement can only be obtained when tops of all rings are in contact — an impractical and dangerous situation.

Note, however, that the degree of compression will not be truly equalized until the tops of all the rings are in contact. But, when such a condition occurs, serious problems will result. If the limit of compressibility is reached before the thermal expansion has been completely absorbed, exceedingly large forces will be transmitted through the pipe line to the anchors and connected equipment. On the other hand, if the joint is compressed only partially, not all of the corrugations will absorb movement to the same degree.

How S-R Joints solve equalization problem

Badger S-R Expansion Joints feature the new Curvilinear Corrugations which naturally assume an "all curve" shape under pressure (diagram 2), assuring more equal distribution of stresses throughout the bellows material. Furthermore, the shape, height and pitch of the corrugations are based on a carefully engineered correlation. Thus, reasonably equal distribution of movement among the corrugations is obtained, even in joints not equipped with reinforcing rings.

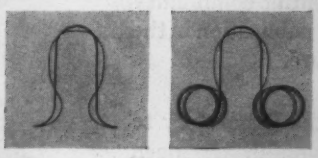

Diagram 2

Badger S-R Expansion Joint. Cross-sections of S-R Joints (Series 50 left, Series 150 right). The movement of the corrugations is shown by dotted and solid lines. Compare configuration and effective height of corrugations, position and size of rings with conventional joint.

Equalization of movement is inherent in the design and functioning of the bellows on Badger S-R Joints. On the basis of provable engineering criteria, the prime purpose of reinforcing rings of any design is to retain the hoop dimension (diameter) of the corrugations when they are subject to internal pressure. This Badger's simple, lightweight tubular reinforcing rings do. But, in addition, the new tubular shape of the rings does contribute to joint flexibility and life by permitting flexing over a more effective portion of the total corrugation height than conventional cast or fabricated equalizing rings.

Better performance, lower cost

Briefly, then, Badger S-R Joints alone offer these advantages: Better equalization of movement which results in elimination of localized stresses and leads to longer joint life; a simple, lightweight design that makes installation easier, eliminates cumbersome castings and fragile mechanical devices; complete range of sizes from 3″ to 72″ made from any workable metal and with a wide choice of accessories.

Badger S-R Joints are probably the answer to your problem. There's an easy and quick way to find out — ask the Badgerman for his recommendations. Write or phone today. Badger Manufacturing Co., 230 Bent St., Cambridge, Mass.

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BADGER S·R EXPANSION JOINTS

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DECEMBER 1959 VOL. 85, NO. 2 ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS Pages 313-546
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THE JOURNAL OF PHYSICAL CHEMISTRY NOVEMBER, 1959
JOURNAL OF METALS
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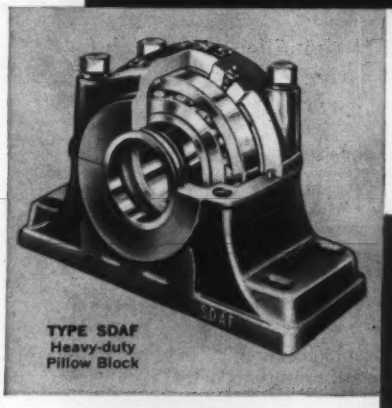

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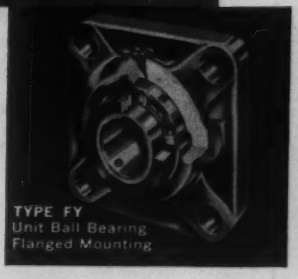

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When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.
When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.
Key: condensate steam steam bubbles air bubbles

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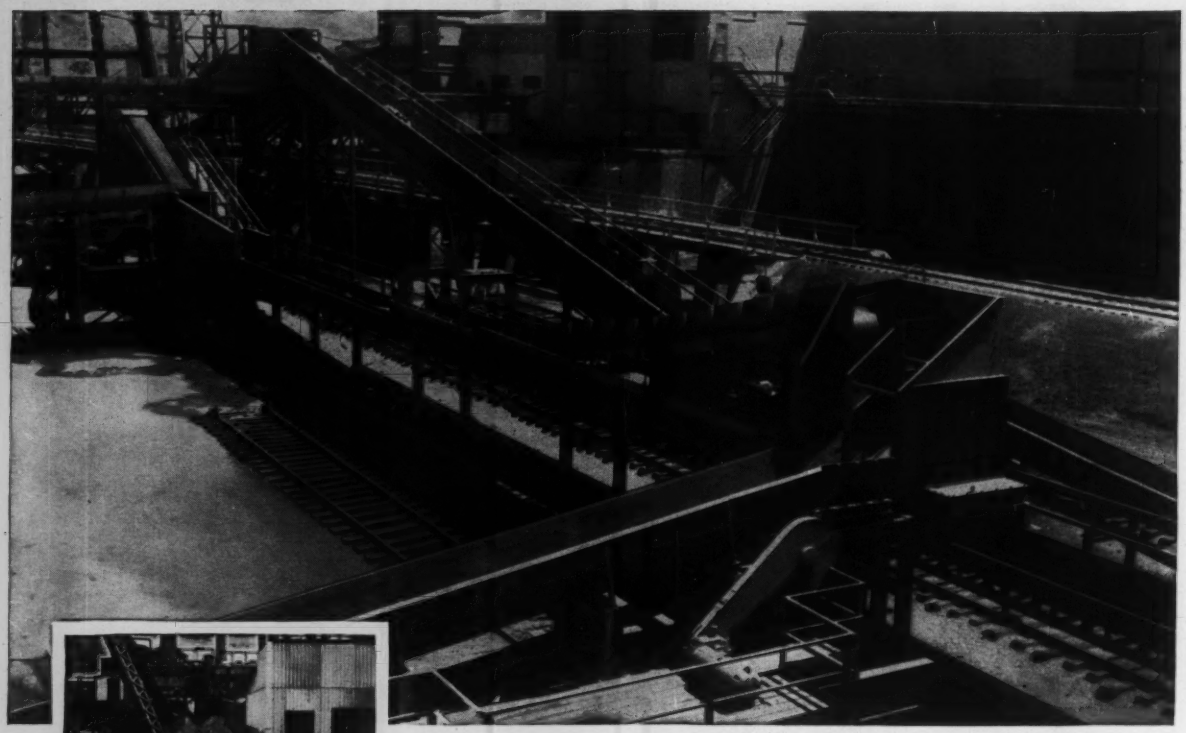
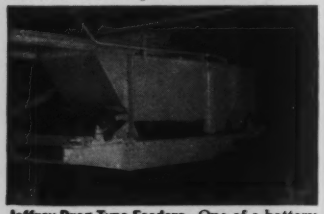


Jeffrey Conveying Machinery was first installed at this pulp and paper mill over ten years ago . . . and selected again for use in these recent additions to the company's facilities.

Jeffrey Type PW Combination Chain with S-212 spur attachment is used on this pulpwood conveyor. Service demands heavy chains with extra large surfaces to withstand wearing action of sand and grit in troughs and return runways.



Jeffrey Drag Type Feeders—One of a battery of feeders under chip storage bin. Chips pass through upper strand of flights to bottom plate. Lower strand carries them to discharge point over belt conveyor.

Jeffrey 36" x 36" Type B Wood Hog—Reduces bark and broken pulpwood sticks from barking drums.

Jeffrey equipment again selected when this mill was extended

The expanded facilities of this pulp and paper mill include Jeffrey conveyors, chain, and machinery...and a lot of credit for their re-specification goes to other Jeffrey equipment installed in the original mill over ten years ago.

Wherever Jeffrey equipment is used, it establishes a solid performance record for efficient, dependable operation. Jeffrey makes a broad range of equipment for conveying, processing, power transmission...equipment that can help you operate at top efficiency. For complete information write The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.

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Scientists at the General Motors Research Laboratories began three years ago to measure and re-evaluate the nuclear characteristics of these rare earth isotopes — their half-lives, photon emissions, thermal neutron cross sections.

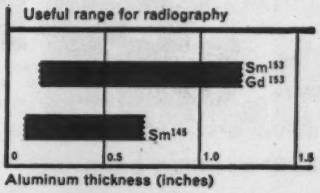
Conclusion: the radioisotopes had attractive possibilities in industrial and medical radiography, emitting almost pure gamma rays or X-rays (photons) in the low energy range of 30 to 100 kev.

The transition from research to hardware came through two key developments. First, cermet pellets were fabricated using only a few milligrams of the rare earth oxides. Then the irradiated pellets were packaged in special bullet-size holders.

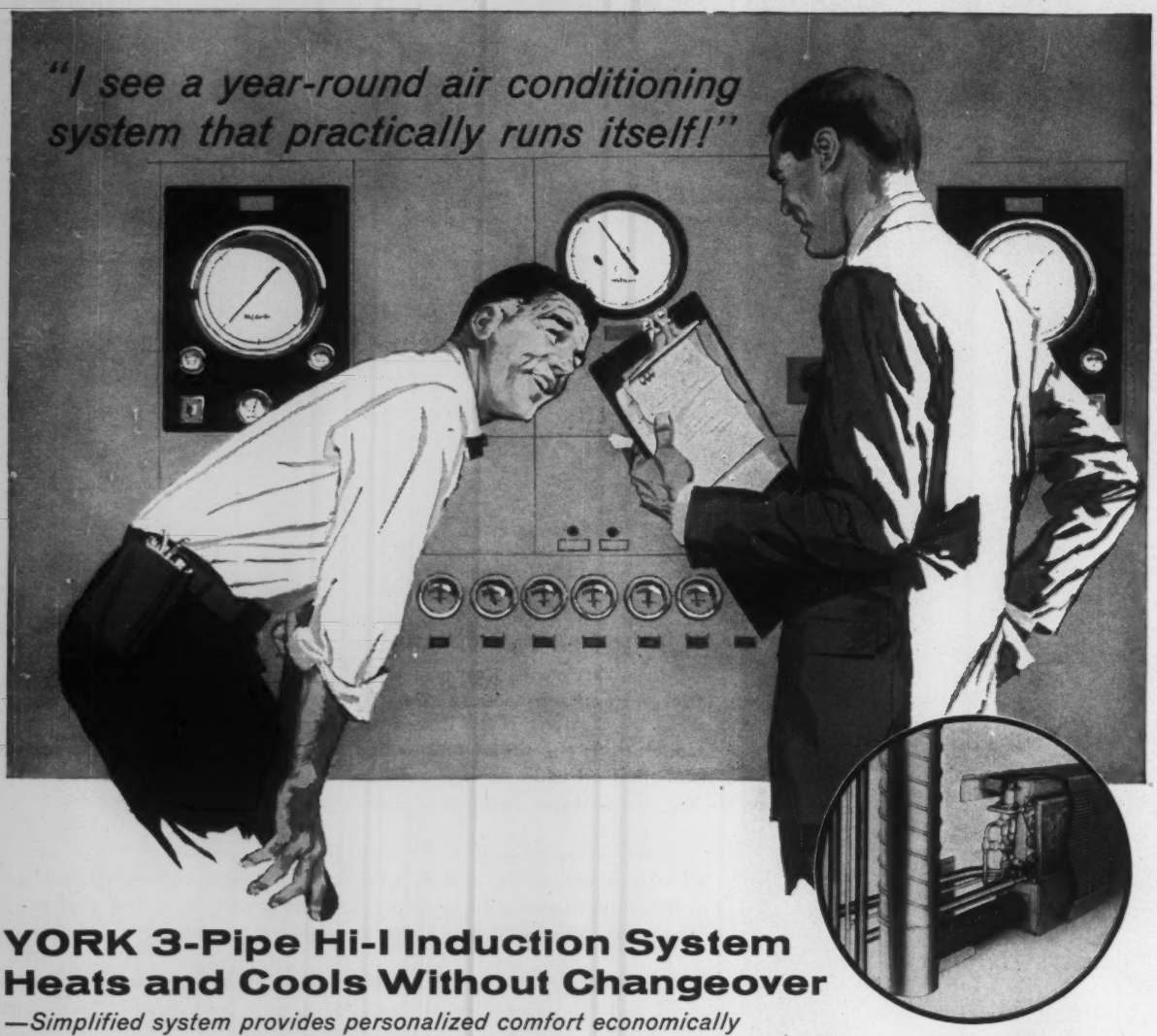
The resulting small, sealed radiographic sources are now being field and laboratory tested. Two excellent applications: "inside-out" checks of hollow shapes inaccessible to X-ray tubes, and radiography of thin steel sections and low density materials such as aluminum or human bone. For example, a recent medical milestone was a chest radiograph of a living person made with a Sm^{153} source. The portable exposure unit to shield the source weighed only 18 pounds.

This isotope radiography program is but one example of the work underway in GM Research's modern isotope laboratory — work that means, through science, "more and better things for more people."

General Motors Research Laboratories
Warren, Michigan



Sm^{153} exposure unit.



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Another YORK Trail Blazer Concept Proved in Action at *Statler-Hilton Hotel, Boston, Mass.*—York 3-Pipe Hi-I Induction System delivers instant personalized comfort to 1,300 guest rooms. Compact, modern induction units replaced radiators, provide heating *and* cooling in same place.

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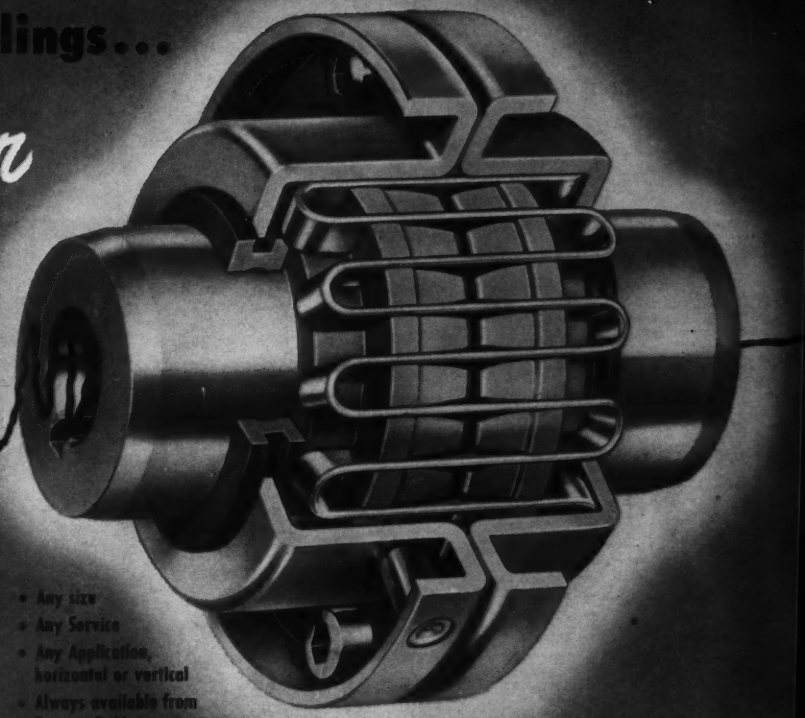

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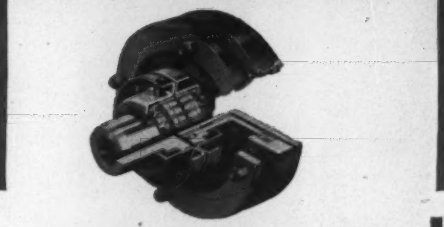

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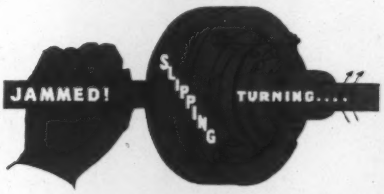
Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

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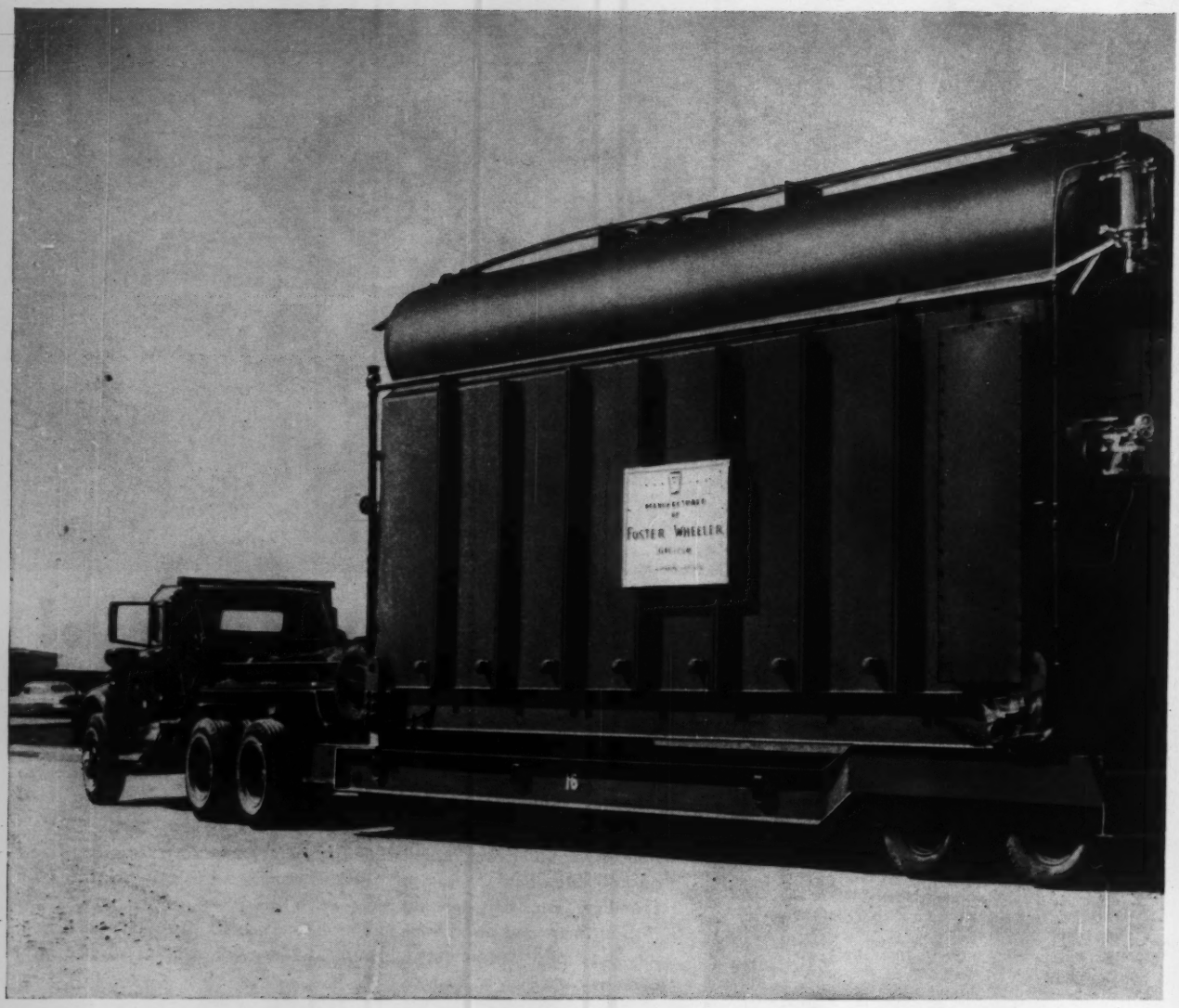

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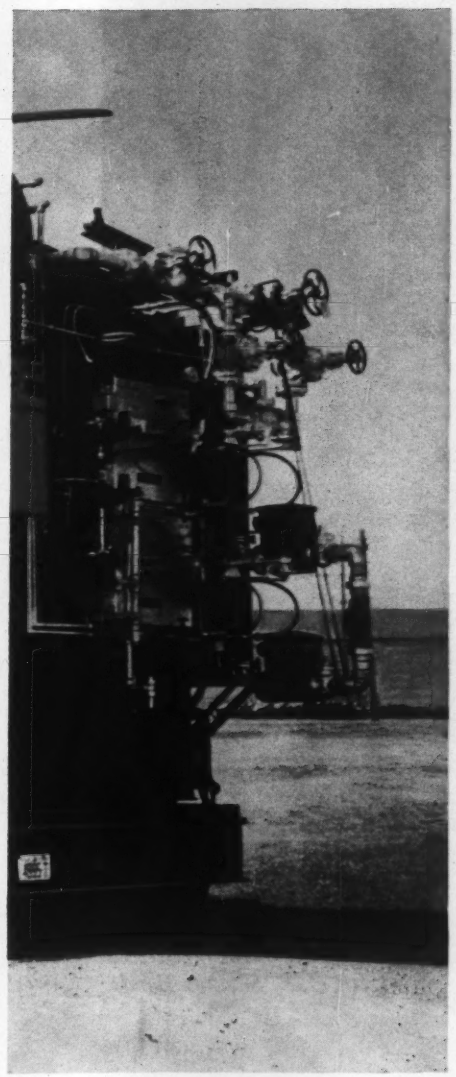

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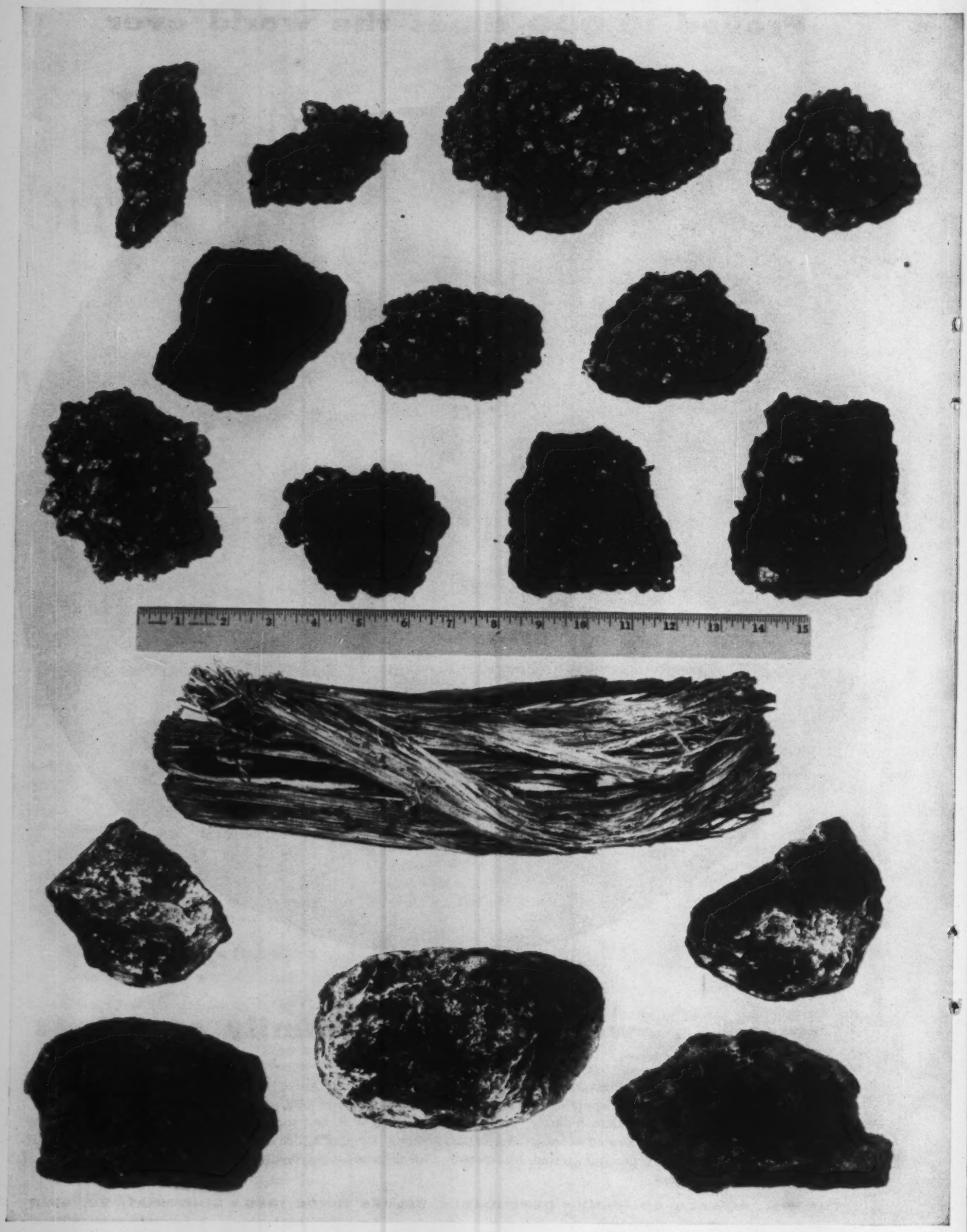

Once in a while...

something big comes along. Maybe it's a piece of wood or ball of pyrites or a chunk of frozen coal. Even in the best managed plants it happens occasionally. When it does, you have a right to expect the feeders to your pulverizers or cyclone burners not to plug or jam.

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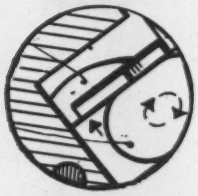

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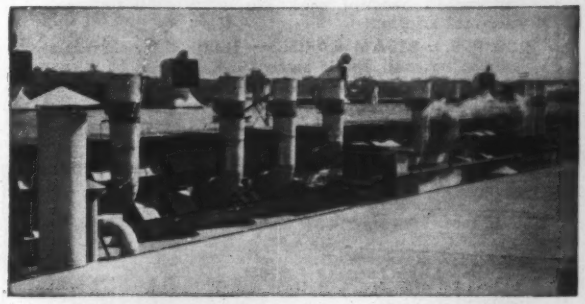

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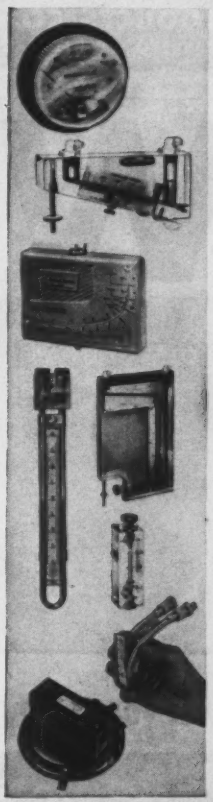

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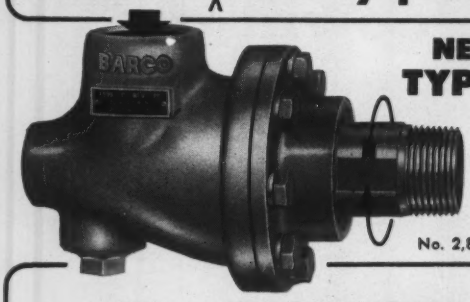

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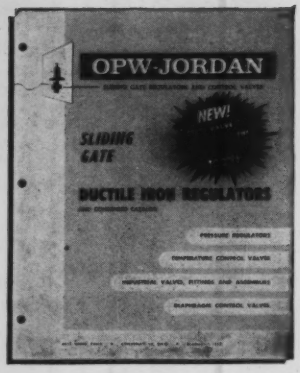

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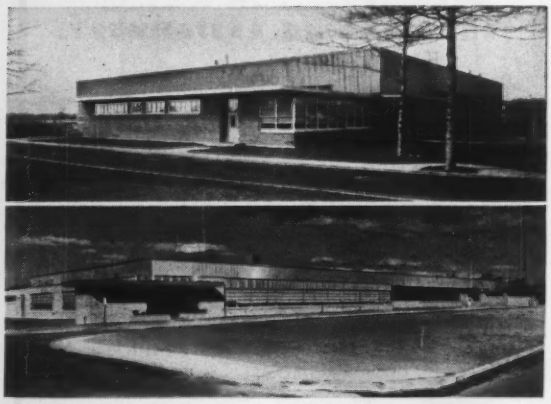
The initial ring-rolling plant



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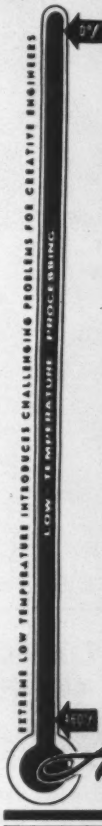

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IBM
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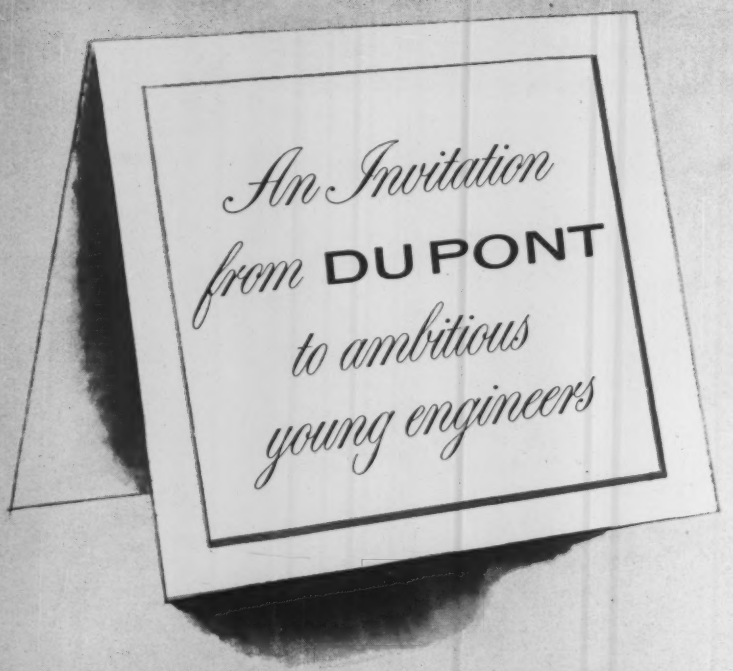

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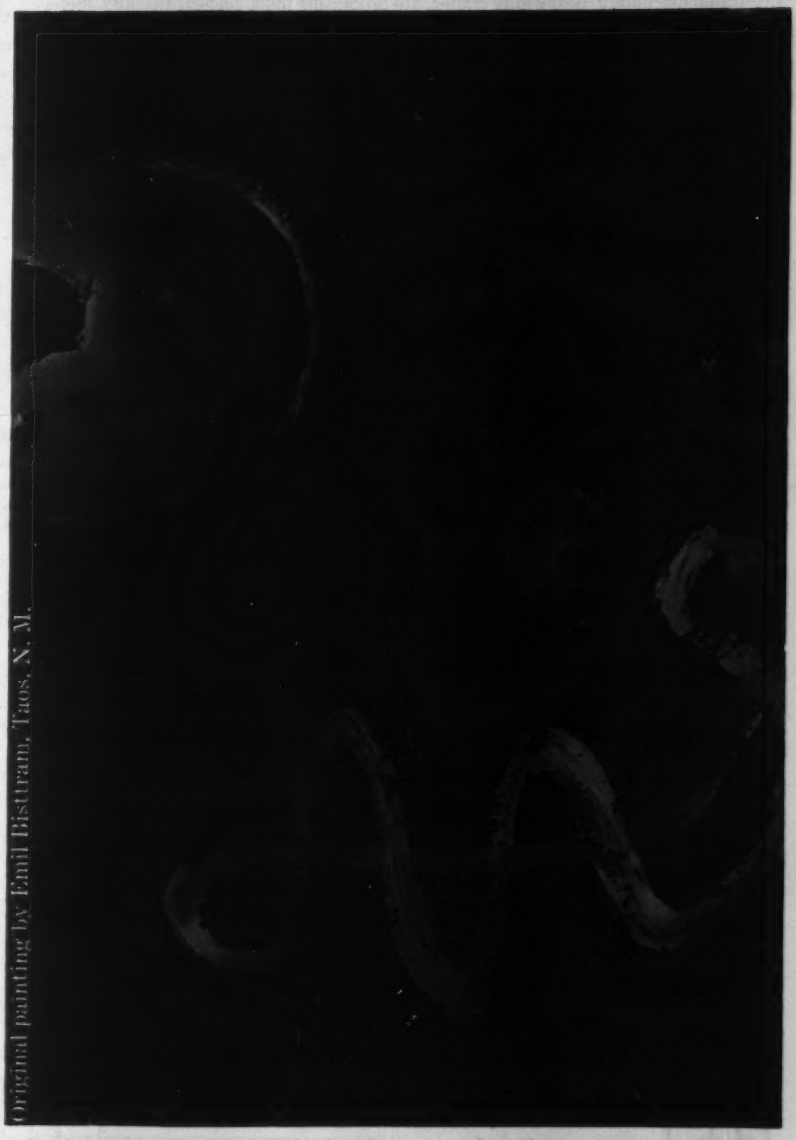

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THE IDEA THAT GREW FOR 100 YEARS

At Bell Laboratories, M. Uenohara (left) adjusts his reactance amplifier, assisted by A. E. Bakanowski, who helped develop first suitable diode. Extremely low "noise" is achieved when certain diodes are cooled in liquid nitrogen.

First practical diode for amplifier, shown here held by tweezers, was jointly developed by A. E. Bakanowski and A. Uhlir.

How basic scientific ideas develop in the light of expanding knowledge is strikingly illustrated by the development of Bell Laboratories' new "parametric" or "reactance" amplifier.

Over 100 years ago, scientists experimenting with vibrating strings observed that vibrations could be amplified by giving them a push at strategic moments, using properly synchronized tuning forks. This is done in much the same way a child on a swing "pumps" in new energy by shifting his center of gravity in step with his motion.

At the turn of the century, scientists theorized that *electrical* vibrations, too, could be amplified by synchronously varying the *reactance* of an inductor or capacitor. Later amplifiers were made to work on this principle but none at microwave frequencies.

Then came the middle 50's. Bell Telephone Laboratories scientists, by applying their new transistor technology, developed semiconductor diodes of greatly improved capabilities. They determined theoretically *how* the electrical capacitance of these new diodes could be utilized to amplify at *microwave* frequencies. They created a new microwave amplifier with far less "noise" than conventional amplifiers.

The new reactance amplifier has a busy future in the battle with "noise." At present, it is being developed for applications in tropospheric transmission and radar. But it has many other possible applications, as well. It can be used, for instance, in the reception of signals reflected from satellites. It is still another example of the continuing efforts to improve your Bell System communications.

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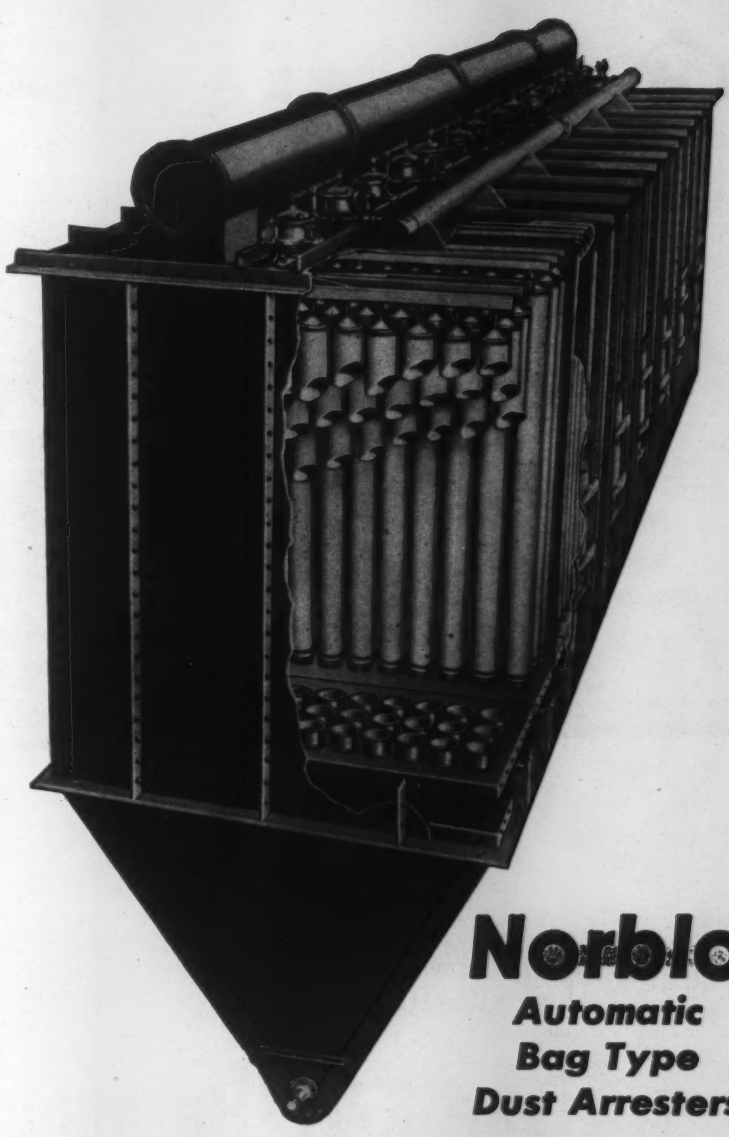

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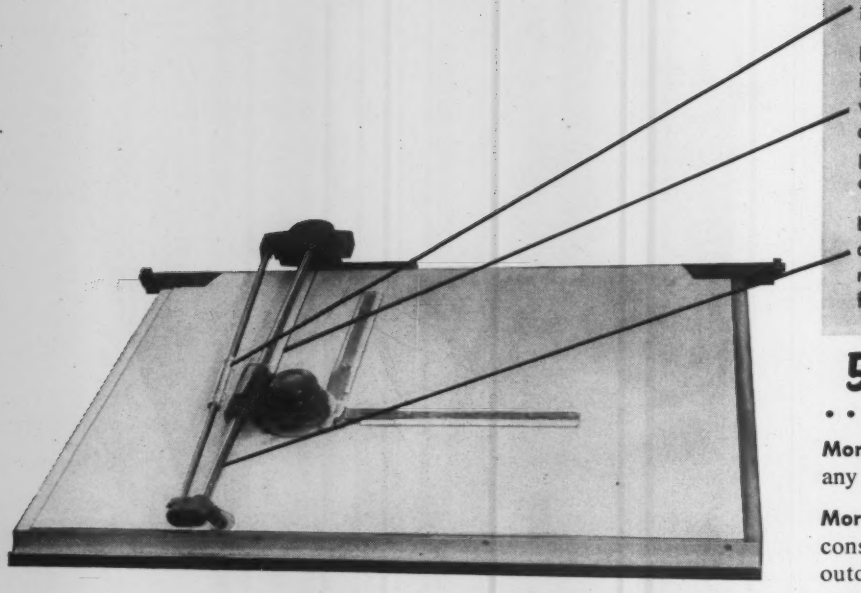

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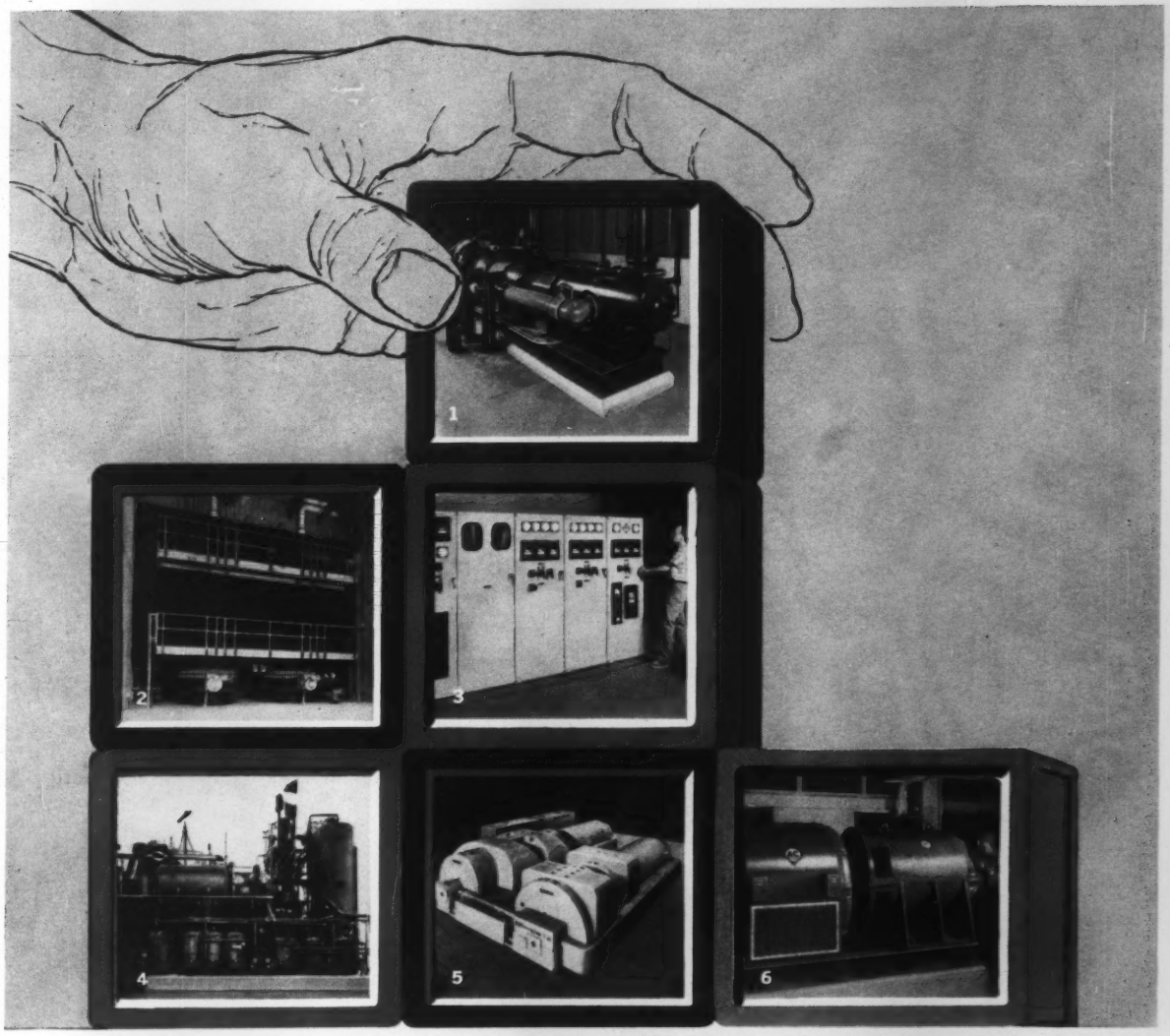

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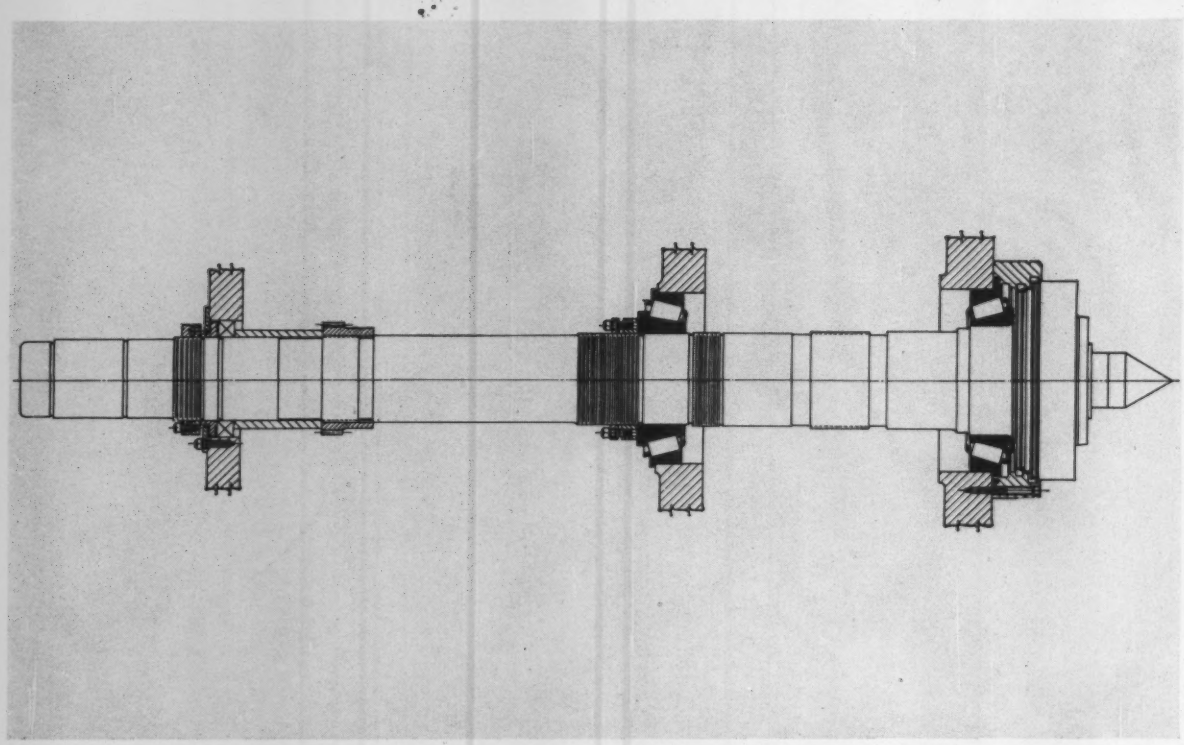
How Monarch assures rigidity, accuracy, with Timken® bearings in "Dyna-Shift" lathe



IN designing their Series 90 Dyna-Shift lathe that can be kept under full load at any speed, Monarch engineers wanted to be sure of rigidity, accuracy and economy. By using 30 Timken® tapered roller bearings at vital points—spindle (shown above), gear box, apron and tailstock—the engineers achieved their objectives. Results from the "90", reports Monarch, show up to 25% more output and 50% greater tool life than with other equipment.

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